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ABSTRACT

This teacher's guide contains a unit of study for teaching about energy in grades four, five, and six. The guide is self-contained and includes the fact sheets students need to work out the activity problems. The unit is organized around the theme of the domed athletic stadium. The students begin by surveying the energy it takes to travel from their homes to the stadium and to operate all the machines that heat, cool, and light the huge arena. These energy users are then related to the sources from which the energy is refined or processed. After students discover the great variety of direct uses of energy and the growth in the demand for more fossil fuel based power, they turn to a study of different indirect uses of oil for which the plastics industry serves as an example. Artificial turf provides the organizer for this section as students study the processing steps involved in making it. The impact of the gap between U.S. consumption and production of oil and natural gas is explored in a puzzle-like activity which provides students with data and requires that they make personal decisions about conserving our increasingly limited supplies of oil and natural gas. In a concluding unit, students use a set of fact sheets on three alternative energy sources for the future and are asked to make a decision about using high-cost fuel to heat a stadium. Teacher background information on energy is also included in the guide. (Author/RM)

DOE/CA/06083-03

The Energy Dome
Social Studies Packet - Grades 4,5,6

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National Science Teachers Association
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Copies of this unit may be obtained from:

U.S. Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

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TEACHER GUIDE

INTRODUCTION

The goal of the "Energy Dome" is to provide fourth, fifth, and sixth grade students with some basic information about the energy we use in modern American life which, in turn, affects the supply of finite fuels, particulary oil and natural gas. This packet informs students of the place of traditional fuels in the United States and leads them into activities that encourage conservation of fossil fuels and encourages them to explore the problems and promises of alternative fuels for the future.

The modern domed stadium was chosen as a theme because there is probably no more obvious or conspicuous user of energy that serves as well for intermediate-grade students.

Using this theme--the athletic stadium--we can talk with students about the direct and indirect use of energy in a framework that moves from the familiar to the unfamiliar. Students begin by surveying the energy it takes to get to the stadium, and to operate all the machines that heat, cool, and light the huge arena. These energy users are then related to the sources from which the energy is refined or processed. After students discover the great variety of direct uses of energy and the growth in the demand for more fossil fuel-based power, they turn to a study of different indirect uses of oil for which the plastics industry serves as an example. Artificial turf provides the organizer for this section as students study the processing steps involved in making it.

The impact of the gap between U.S. consumption and production of oil and natural gas is explored in a puzzle-like activity. This puzzle provides data leading students into activities that require personal decisions about conserving our increasingly limited supplies of oil and natural gas. In a concluding unit, students use a set of fact sheets on three alternative energy sources for the future. The fact sheets serve as the information resource for students as they work out their activity problems. The concluding activity encourage

students to make a decision about using high-cost fuel to heat a stadium. This activity brings together some of the ideas presented in the four units of the "Energy Dome."

ACTIVITY MASTERS

You will find thirty activity masters in the "Energy Dome" packet. Each master is designed to help you implement the lessons. They are suitable for thermo-faxing and will make sufficient copies for a class set.

Answers or suggested student responses have been included in the text of the Teachers' Manual.

TEACHERS' MANUAL

The teacher material contains a brief overview (statement about the purpose) of each lesson. The objectives point toward the measurable goals for students to achieve; and the materials and time allotment provide basic information in simplified, easy-to-read style.

All lessons begin with a suggestion that will move the lesson forward or emphasize the thrust of the lesson. Except for initial lessons in each unit, which acquaint the students with routine terms and skills, the activities in each unit can be done in any order. However, it is recommended that you use the units in the order we have structured, as the lessons and units tend to build on one another. You will know the abilities of your students, or course, and can best decide if lessons have or do not have applications for your class.

In the optional activities, it is hoped that the tasks students perform will help them to reinforce basic skills as well as to learn additional facts about energy.

TEACHER BACKGROUND INFORMATION

Learning about energy has become desirable and practical with the onset of the high-cost energy era.

In this minicourse, energy is studied and understood in terms of direct energy use, indirect (or hidden) energy use, conservation of limited fossil fuels, and comparisons of different kinds of alternative energy sources for the future.

The "Energy Dome" emphasizes the various ways energy is used and what is involved in energy transformations. It is hoped that, except for the unit on alternative sources of energy -- solar collection, coal gasification, and nuclear fusion -- material in the Teachers' Manual gives adequate background information.

Information about these future

energy sources or new fuels follows:

Solar Collectors

Solar collectors are generally in the shape of a flat box perhaps three feet on a side and a few inches thick. The back of this box is blackened and it is covered with a transparent sheet. When oriented toward the sun, usually by placing it on a south-facing roof, the blackened surface is heated by solar radiation. Circulating air or water through this box carries the absorbed heat to some storage device such as a tank of water.

To use the heat stored in this water tank, coils of tubing serving as "heat exchangers" are placed in the tank permitting a fluid to be heated as it passes through the tank. In the simplest terms, space heating could be accomplished by passing air through the tank and into the building to be heated. Hot water could be obtained by simply passing water through the tank. Interestingly, this tank of hot water can also provide for space cooling. A "working fluid" is converted from liquid to vapor by passing through the tank and the vapor circulates through pipes in the building and absorbs heat. The same process is used in gas refrigerators.

There are many designs for solar collectors, as well as the storage and circulation components. All are somewhat experimental so the economics are rather unknown. Solar energy is not uniformly available, being obviously affected by average cloudiness and latitude. While it is judged that all regions of the U.S. have some potential for using solar energy, we have too little experience to know the potential in all regions.

Coal Gasification

Coal is an attractive resource, at least in the intermediate term (the next 50 years), because it is so much more plentiful than natural gas or oil in the U.S. Estimates suggest that the U.S. has at least ten times the recoverable energy in the form of coal as it has in natural gas and oil. The difficulties of using coal are primarily environmental. Mining, particularly the strip mining of our western coal, is disruptive of the land. Burning it directly in industry or in electric generating plants leads to polluting the air with compounds of sulfur and nitrogen. Elaborate equipment to remove these pollutants from the "stack gases" is an expensive solution.

By converting coal to a combustible gas, the air pollution problem can be avoided. In the process of gasification, the coal is heated in the presence of hydrogen and converted to a gas of a carbon and hydrogen compound such as methane (CH^4). In the process, the contaminants

such as sulfur are removed. The resulting gas can be transported and burned cleanly and easily as a substitute for natural gas. It can also be used as a source of chemicals for industry.

Methods and plants for gasifying coal have been present for decades, but all currently available methods produce a gas that is more expensive than available alternatives. Current research is expected to improve the methods and as both the costs are reduced and the price of the alternatives increase, gasification is likely to be adopted.

The primary problems remain the disruption of the land for mining and the need for large quantities of water for the process. Much of the coal lies in the dry western states where water is already at a premium and in great demand for irrigation. In the future, the environmental damage of mining may be avoided if we learn to gasify coal in the ground without mining it first.

Nuclear Fusion

The primary attraction of nuclear fusion is that the fuel supply is essentially unlimited, while the primary discouragement comes from the difficulty of achieving a controlled fusion reaction. The process involves fusing together very light molecules which produce energy. The commonly considered reactions are to combine deuterium (an isotope of hydrogen) with itself or with tritium (another isotope of hydrogen). Both reactions produce energy and by-products that are not dangerously radioactive. Though these special forms of the hydrogen atom (or isotopes) are much less common than the basic hydrogen atom, they are still very plentiful. Deuterium is found in one water molecule of every 6500. Considering the water in the world's oceans, there is enough deuterium to supply twice the world's current energy consumption for 50 billion years. Thus, the supply of the resource is no problem.

But the technology is a problem. To accomplish a fusion reaction requires that the particles be confined and heated to 100 million degrees centigrade or higher. No materials can withstand these temperatures, so we must seek new methods of confinement. Laboratory experiments are currently being conducted using lasers or magnetic fields, but the status of these efforts, after 20 years of hard work, is that we have still not successfully obtained as much energy out of the reaction as has been used in heating the materials. At this point we do not know how to produce a controlled fusion reaction, although much research is still going on. Opinions on the liklihood of success differ.

It should be mentioned that the sun's energy results from just such fusion reactions. There the confinement is accomplished with gravity. The hydrogen bomb is also a fusion reaction but hardly controlled as required for our purposes.

If we learn how to sustain a controlled fusion reaction, much work will remain until the process can be used to produce energy commercially. We must develop materials and systems to safely remove the heat from the reactor and put it to use, probably by generating steam to power electric generators. This commercialization of the fusion process will take many additional years and is expected to be extremely expensive.

WHAT'S IT LIKE UNDER A DOME?

Overview

This lesson begins by having your students look at the human energy expended in an athletic stadium. Then the domed stadium is introduced. It becomes the focus for a study of the forms of energy--heat, light, and motion. From there on students study how lifestyle and low-cost energy influence one another.

Objectives

Students should be able to:

1. Identify some of the ways energy is used directly.
2. Infer that a dependence on energy is related to a desire for comfort.

Materials

Copies of Activity Masters 1-4.

Time Allotment

One class period.

Activity	Procedure
Classifying How do people and machines use energy directly?	ACTIVITY MASTER 1 [redacted] Ask students to list as many ways as possible that sports players use energy directly. Start the list with <u>kicking the ball</u>. Move the discussion forward by asking: How do players depend on energy? Do all humans depend on body energy? Why? Can machines do the same things? How do machines get energy?
How is energy used directly in a stadium?	ACTIVITY MASTER 2 [redacted] Distribute ACTIVITY MASTER 2. Continue the motivating part of this lesson by involving as many students as possible

How is energy used directly in getting people <u>to</u> the stadium?

in the class discussion. Then have students complete the questions on the activity master.

Note: Discussing the concept of energy at this grade level may present some problems. To say that energy is the ability to do work may be too abstract. The idea that energy makes things work may be more helpful. Have students give examples of energy helping people do things. Students may also like describing what they think energy is. Compile a class list of these interpretations.

ACTIVITY MASTER 2

Questions and Answers:

[redacted]

Acquiring and Reporting Information from a Picture and a Key

1. How do people get to the stadium? (Cars, buses, trains, airplanes.)
2. What fuels are used for transportation? (Gasoline, jet fuel, electricity for electric trains.)
3. How is energy used in the stadium? (Heating/cooling; lighting. Additional ideas: heating water, heating food, run the scoreboard, etc.)
4. What fuels heat, light, and cook food in the stadium? (Fuel oil, natural gas, electricity.)

Inferring Information

The domed stadium presents a "weather-free" environment. How does "weather-free" add to our comfort? But does it also make us <u>dependent</u> on a lot of energy? How?

ACTIVITY MASTER 3

[redacted]

Applying the Learning

Advance the lesson with the question: Why is energy an important topic today? Could we, for example, have large shopping malls without a large

supply of energy available? How does a shopping mall depend on energy? Have students complete ACTIVITY MASTER 3 as a take-home assignment.

ACTIVITY MASTER 4

[redacted]

Acquiring and Reporting Information

Have students collect information about the forms of energy--heat, light, and motion--used in hometown stadiums. Report the information in a chart.

Optional Activities

Writing Letters and Making Reports

Give students further practice in gathering and reporting information by writing letters to public relations offices in various domed stadiums.

Divide the class into groups of four. Their tasks would involve comparing facts about capacity, kinds of stadium activities, frequency of use, size of crowds, amount and type of energy consumed, and costs of stadiums.

The addresses are:

Astrodome
Public Relations Dept.
Houston, Texas

Pontiac Silverdome
Promotions/Public Relations
1200 Featherstone
Pontiac, Michigan 48057

Kingdome
Division of Sales & Promotion
Seattle, Washington 98104

Louisiana Superdome
Public Relations
1500 Poydras Street
New Orleans, La. 70113

Exploring Local Recreation Facilities

Other students might like to ask these questions about stadiums

in their hometowns and report on them:

1. When is the stadium used? For which activities?
2. How do people get to the stadium?
3. What forms of energy are used in the stadium?
4. How is human energy used in the stadium?

HOW IS THE DOMED STADIUM PART OF THE LARGER ENERGY ENVIRONMENT?

Overview
In this lesson students again refer to the drawing of the domed stadium, but now focus on the supply lines of energy to the stadium. The stadium becomes part of a larger energy environment.

Objectives
Students should be able to:
1. Draw energy symbols on a map and map key.
2. Explain the network that moves and produces energy.

Materials
Copies of Activity Masters 5-7

Time Allotment
One class period.

Activity	Procedure
	ACTIVITY MASTER 5 [redacted]
Discussion	Distribute ACTIVITY MASTER 5. Ask: How does the energy supply get to the stadium? How could this be shown on the map? Review the purpose of a map key. Use a large wall map and discuss the terms Key, Legend, and Scale. Review energy forms shown on the drawing Key that are used in the stadium itself and in transporting people to the stadium. Have students suggest appropriate symbols for each energy form. Students should draw these on the map key.
Using Symbols	What symbols should be used to show energy being transported to the stadium? How can we show

a pipeline? A delivery of fuel oil by truck? Natural gas pipes? Electricity coming in to the stadium? How do we show underground electric wires?

Deciding Energy Routes

Use the appropriate symbols to draw energy routes to the stadium. Have students compare their routes with a classmate.

ACTIVITY MASTER 5
Questions and Answers:
[redacted]

1. (PIPELINE) How does natural gas get to the stadium?
2. (WIRES) How does electricity get to the stadium?
3. (TRUCKS) What brings fuel oil to the stadium?

ACTIVITY MASTER 6
[redacted]

Collecting Information

Check for at least four items mentioned in each list.

ACTIVITY MASTER 7
[redacted]

Applying the Learning

Students draw maps of their neighborhood and use symbols to show how energy gets to their house.

Optional Activities

Investigating and Reporting

Have interested students report on sports stadiums of the past and compare these with our modern ones. Use these guide questions:

1. When and where was the stadium built?
2. What activities was it used for?
3. How often was it used? Any time of day?
4. How many people did the stadium hold? Less or more than a modern stadium?
5. Was there a way to keep cool (or warm) in an ancient stadium? How?

6. What forms of energy could you see in ancient stadiums?

Note: The Horizon Book of Ancient Rome (Robert Payne. American Heritage Press: New York, 1970), is one good reference for elementary children dealing with this topic.

Books about Greek and Roman theatres are good starting points for reports on this topic.

PRODUCING AND MOVING ENERGY

Overview This lesson introduces the flow of basic energy fuels in the processing steps. The stadium becomes much smaller in scale as the energy network stretches away from the stadium to the fuel source.

Objective Students should be able to describe how energy is provided in a region.

Materials Copies of Student Activity Master 8

Time Allotment One class period.

Activity	Procedure
Tracing energy	ACTIVITY MASTER 8 Questions and Answers [redacted] 1. Four basic resources are: Coal, uranium, oil, and natural gas. 2. Resource requiring fewest processing steps is natural gas. 3. Which require the use of electric generating plants? Coal, uranium. 4. Oil is processed in the refinery.
	Optional Activity
Inviting a speaker, listening and taking notes	Make up a name for an energy club and arrange a time for the club to meet. Have students who join the club elect officers and draw up rules. Then invite a speaker from a local utility company to come to a meeting and talk about how electric power and heating fuels are provided to homes, stores, schools, and recreation facilities. Club

members should make up a set of questions, such as these:

1. What basic fuels are used in your plant?
2. How are they transported?
3. Where do they come from?
4. What should people do to conserve these fuels?
5. What fuels will be used in the future?
6. Has the company ever had to deal with a shortage?

PLACES AND ENERGY NEEDS

Overview Energy use in stadiums differs from region to region. Two factors that influence the use and cost of energy are climate and the location of fuel resources.

Objectives Students should be able to:

1. Locate basic fuel resources on a map.
2. Interpret a temperature chart in terms of energy needs.
3. Describe how energy is transported from the resource location to the place where it is to be used.

Materials Copies of Student Activity Masters 9, 10

Time Allotment One class period.

Activity	Procedure
	ACTIVITY MASTER 9 [redacted]
Map Reading	Where in the United States are the following resources found in large quantities: Coal, uranium, oil, natural gas? Have students point out these places and use the map compass to identify Northeast, Southeast, West, Etc. Introduce the notion of Sunbelt and Frostbelt regions. Additional discussion points might include a description of hydro-power in the Northwest and the importation of natural gas from Canada. Answers to Questions for Activity Master 9 1. Houston (Astrodome) Oilers 2. Pontiac (Silverdome) Lions 3. Seattle (Kingdome) Seahawks 4. New Orleans (Superdome) Saints

5. Energy-related name: Oilers
6. Astrodome; Superdome have large energy resources around them.

ACTIVITY MASTER 10

[redacted]

Temperature and Energy Needs

Reading Temperature on a Chart

Note: Some students may have difficulty with the meaning of "average". Substitute "typical", or the phrase, "This is the daytime temperature on most summer days (or winter)".

The chart shows the differences between the sources for electricity and sources for heating fuels. Point out that air conditioning is done electrically.

Questions and Answers

Acquiring and Reporting Information

1. What is the average temperature in July in Seattle? (64.5°)
2. Which city has cold Januarys? (Pontiac)
3. Which cities have similar summer time temperatures? (Houston; New Orleans)
4. Based on the winter average temperature, which stadium would probably have the highest heating bill? (Pontiac)
5. Which would have the highest air-conditioning bills? (Houston; New Orleans)

Generalizing

Chart Answers (any order)

1. Natural gas
2. Coal
3. Oil
4. Uranium
5. Water power (Hydroelectric)

Optional Activity

Applying the Learning

Have students record daily temperatures at their school or

listen to the local weather news. Then compute the weekly or monthly average.

Ask the principal to tell the class about the average fuel consumption and monthly cost to heat the school building.

THE HIDDEN USES OF ENERGY

Overview — In this lesson students learn that energy is used to make the many products we use in our homes and in our leisure time activities. Students think about the many different products made from plastic.

Objectives — Students should be able to:

1. Define synthetics and name some synthetic products.
2. Explain how energy is used in the manufacturing process.

Materials — Copies of Student Activity Masters 11, 12

Time Allotment — One class period.

Activity	Procedure
	ACTIVITY MASTER 11 [redacted]
Classifying	American manufacturers make many products of plastic. List all the different products made of plastic that can be seen in the picture. What are some other plastic objects that can be found in the stadium, but cannot be seen in the picture? Mention artificial turf. Students can begin to list plastic articles in the classroom or pieces of their own clothing that are made of synthetic materials. Ask: How long a list do you think we can make?
Learning new words	Introduce the word petrochemical when you draw the class' attention back to artificial grass used in the domed stadium. Petrochemical is any chemical derived from petroleum or natural gas. (Petro from petroleum; chemical,

pertaining to the properties of a substance.)

Comparing

How do real grass and artificial grass compare? List the good and bad points. Why is artificial grass used in domed stadiums? Would real grass grow?

Optional Activities

1. Search for a picture of uniformed football players thirty years ago. Have students tell the differences they see between the protective equipment worn then and now.

Inferring

2. Have students examine Want-Ad sections of the newspaper or Yellow Pages of phone book and list products made from plastic. Explain how plastic products have changed the way we live.

3. Have students plan a wall mural or bulletin board display that will show the indirect uses of basic fuels. Start with the products and work back to the fuel sources as the lessons in this unit progress.

ACTIVITY MASTER 12

[redacted]

Investigating and Reporting

4. Make a report on the general topic of plastics, similar to the one on ACTIVITY MASTER 12.

Teacher Use Only

> Note: Plastics are man-made materials in contrast to nature's materials like wood and metal. A generally accepted definition is: Any group of materials consisting wholly or in part of combinations of carbon with oxygen, hydrogen, nitrogen and other organic and inorganic elements which, while solid in the finished state, at some time in its manufacture is made liquid, and thus capable of being formed into various shapes, most usually through the application, whether singly or together, of heat and pressure.

from, The Story of the Plastics Industry. 12th revised edition, Don Masson, ed. The Society of the Plastics Industry, Inc., N.Y.

Classifying

5. Bring various sports' articles to the classroom. These should be articles made from synthetic materials. Encourage girls to bring in articles of clothing and equipment from sport activities, such as tennis racquets, volley balls, etc. Plan a wall display showing men and women in various sports.

OIL TO TURF: AN INDIRECT ENERGY NETWORK

Overview

In this lesson students trace the steps in making artificial turf. This example is used because it presents the production steps in fairly clear terms and is linked to the general theme of the unit. It also helps students understand that many workers are employed at each step in the process.

Objectives

Students should be able to:

1. Describe some of the indirect uses of oil and natural gas.
2. Explain the importance of transportation in manufacturing and delivering the goods people use.

Materials

Student Activity Master 13 (transparency with overlay); Sample of artificial turf, if possible

Time Allotment

One class period.

Activity	Procedure
	ACTIVITY MASTER 13 [redacted]
Interpreting a flow chart	Use transparency overlay of the flow chart showing the process steps of artificial turf.

Guide Questions:

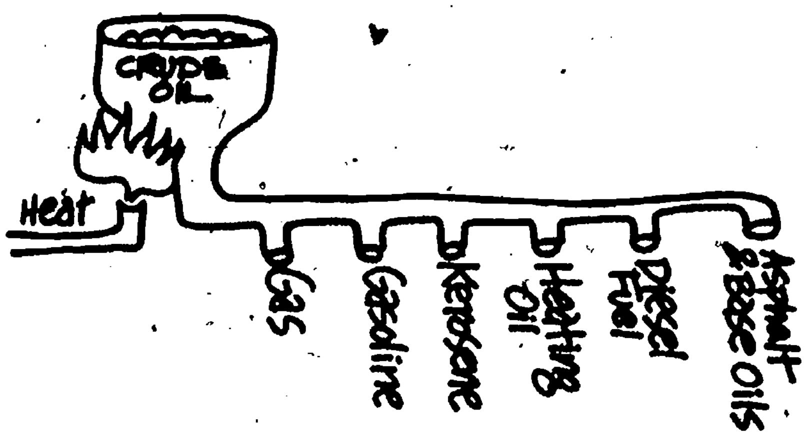
1. How many steps do you see from oil well to stadium? Include the transportation steps. (Eight)
2. At what places does oil change into something else? (Refinery, Petrochemical Plant, and Fabrication Plant.)
3. What moves oil from place to place? (Trucks, pipelines.)

Introduce these new words:

Refinery. A place where oil is broken into components by using heat.

Components. Illustrate this word by using the example of boiling maple tree syrup to make sugar. Another is sugar plus water plus heat makes candy or syrup. Ask students to think of other examples of components.

Illustrate components of crude oil by putting the following drawing on the board.



Petrochemical. (See definition in Lesson 1 of this unit.

Fabrication. The process of manufacturing or making something.

Other New Words. Discuss the meaning of other words on the transparency.

Tracing the Energy Flow in Manufacturing Artificial Turf

Ask students to classify each Product they see. Each Place; and each Transportation.

Discuss the flow diagram. Use these guide questions:

- Where might you see oil or an oil-based product? (Oil well, refinery, petrochemical plant, manufacturing plant, in the truck and pipeline; in artificial turf in the stadium.)

- What are the names of the product as it moves from place to place? (Crude oil; oil fraction or petrochemical compound; nylon; artificial turf.)

- How many processing steps are there? What are they? (Three. Refinery, Petrochemical Plant, Manufacturing Plant.)

- If the oil well stops pumping, what places and products will be affected? What will happen to transportation? (All places, product, and transportation will be affected.) What jobs will be affected? (All of them. Point out the relationship between jobs and energy.)

- How is energy used to get oil from the ground to the pipeline? (Pump.)

- How is energy used, do you think, at the refinery? (Make machines run; heat the oil that is used in the refinery; lights, heat the building, etc.)

- What other places on the diagram have similar energy needs to those in the refinery? (Petrochemical Plant; Manufacturing Plant.)

- What are the forms of energy that provide space heating, cooling, and lighting? (Oil, natural gas, electricity.) This is a review question.

Concluding the Lesson

Discuss how the production of artificial turf involves people, places, resources, and energy. For example, technical ability and modern ideas led to the building of the Astrodome in Houston. The problem of grass

started with the difficulty of growing real grass indoors under artificial light. The chemical companies were asked to create a surface that would be suitable for playing on.

Optional Activities

Listening and Discussing

Invite a local weaver to come to the classroom and demonstrate the craft of weaving and the operation of a loom. Have students plan ahead to ask questions similar to these:

1. What kind of energy, in addition to human energy, is used in home weaving?
2. Do weavers use chemicals?
3. How does the weaving craft differ from the manufacturing process?
4. What might happen if everyone decided to use only hand-made rugs? Who might be affected? Explain.

Have students discuss this question: How important is artificial grass? Can you think of things more important?

Have a small group point out the layers of energy use in the flow chart. For example, the pump at the oil well uses energy; and when manufacturers made the pump, they used energy. Have group find other examples and explain them to their classmates.

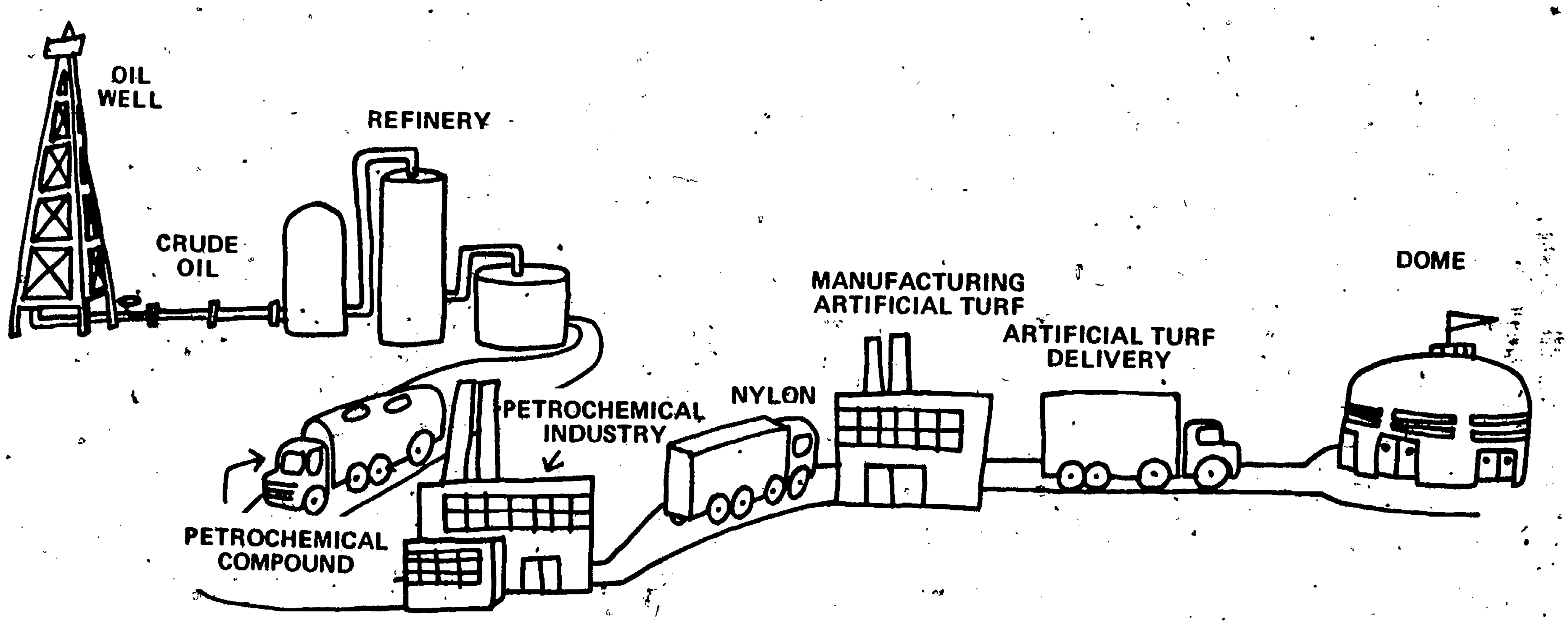
Making Reports

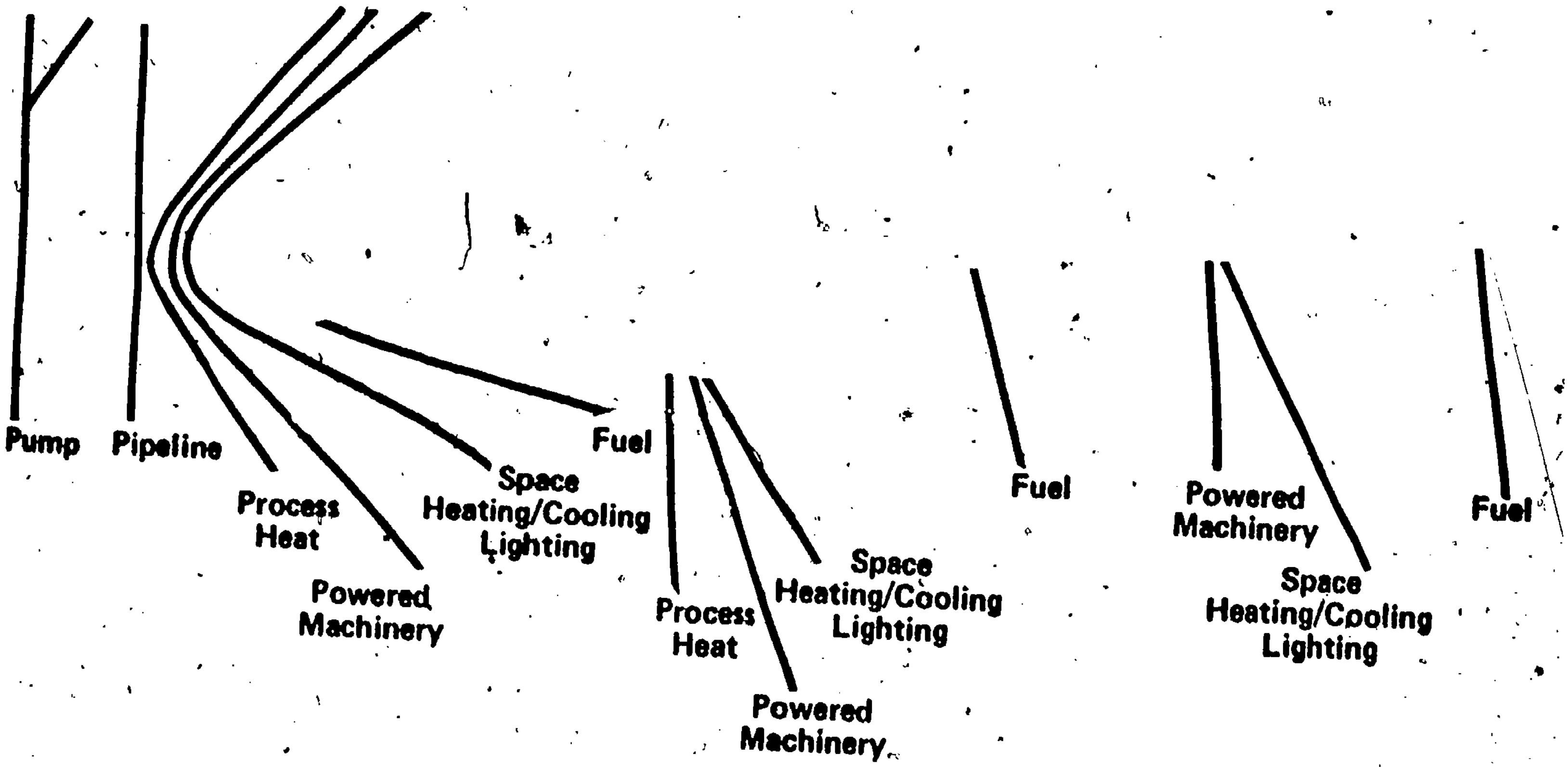
Have a small group use the three titles: Place, Product, Transportation and find out about locally manufactured products. Make a report.

Have students think of the ways artificial turf can be compared to the energy that is needed to maintain natural turf. Make a report.

Several students may enjoy looking for an advertisement that stresses using energy for a better America. Suggest that they think about the meaning of "better". Put these ideas on paper.

OIL to TURF: AN INDIRECT ENERGY NETWORK




Pump
Pipeline
Process Heat
Powered Machinery
Space Heating/Cooling Lighting
Fuel
Process Heat
Powered Machinery
Space Heating/Cooling Lighting
Fuel
Powered Machinery
Space Heating/Cooling Lighting
Fuel

MAKING A FLOW CHART

Overview This lesson encourages the students to apply the knowledge acquired from the previous lesson and again deals with a flow chart. They make a flow chart to show how food gets to the table from the farm, and point out the places where energy is used in the food network.

Objectives Students should be able to:

1. Explain through the use of a flow chart the elements of the food production network.
2. Describe how energy is used at each step in the network.
3. Identify the ways humans depend on and are involved with the farm-to-table network.

Materials Student Activity Masters 14, 15

Time Allotment One class period.

Activity	Procedure
	ACTIVITY MASTER 14 [redacted]
Classifying	Duplicate scrambled pictures of the food chain steps. Cut out enough pictures to give each student a set of the four steps and the forms of transportation.
Putting It Together	Have students cut them out, unscramble them, and paste them in the correct order on another piece of paper. They can draw in the roads for the cars and trucks and paste the cars and trucks in the proper road and track. Next, circle the places where energy is used. Then have them write a story about their favorite food and explain the relationship between the food in the kitchen at home and the food

as it grew on the farm. In the story they should explain the importance of transportation and having energy available for all steps in the food network.

ACTIVITY MASTER 15

[redacted]

Looking at Percentages

A quick way to show how much energy is used in the various steps of the food chain is to distribute the picture of the man eating the hot dog. Point out that the portions of the hot dog are not evenly divided. Some parts of the food network have higher energy requirements than other parts. Explain that the lengths taken by each "bite" correspond to the percentages of energy used in the production and consumption of food--in this case, a hot dog and bun.

If you prefer to add more student activity to the exercise, you might want to ask the following:

1. Can you rank order all the energy users in the food network, from the largest energy user to the smallest? (Food processing, Preparation, Growing grain and raising beef; Marketing; Transportation.)
2. Make a circle graph showing these same percentages. Put a title on the graph.

Advanced Learners

Classifying

Ask these students to identify and list the ways energy is used in the flow chart. They will probably identify these:

Food Production. Farm machinery, construction of farm buildings, heating and lighting these, pesticides and herbicides. (They may not know, however, that energy is involved in the production of pesticides and herbicides. These subjects make good topics for special reports.)

Food Processing. Machinery and equipment in various food industries, manufacturing and baking, canning, freezing; heating and lighting buildings.

Marketing and Distribution. Warehouse heating, lighting, and storing; refrigerating in stores and warehouses; automatic vending machines, etc.

Food Preparation. Kitchen cooking, refrigerating, and freezing; running small appliances. Commercial kitchens: cooking, baking freezing equipment; restaurant construction, etc.

Transportation. Trucks, cars, railroads, boats, ships, airplanes.

Optional Activities

Field Trips

1. Take a field trip to a local food processing plant. Plan to interview the production manager and ask about the places where energy is used.
2. Visit a fast-food restaurant. Investigate the energy used in transporting food supplies. Ask students to write a report comparing food preparation 50 years ago with preparing it in a fast-food place.

DIRECT AND INDIRECT ENERGY USES

Overview

This lesson gives students some idea of the distinction between direct and indirect (hidden) energy use. It also brings together some of the ideas previously presented and asks students to compare these energy uses.

Objectives

Students should be able to:

1. Read and compare energy percentages on a bar graph.
2. Describe specific uses of energy and determine which are direct uses and which are indirect.

Materials

Student Activity Master 16

Time Allotment

One class period.

Activity	Procedure
	ACTIVITY MASTER 16
	[redacted]
Comparing	Ask students to point out the way energy is being used in different places in the picture of a car. These places have been listed on the graph.
	They may want to discuss the differences between direct uses and indirect uses of energy shown in the drawing.
	Ask students to read the bar graph and answer the questions.

Answers to Questions for Activity Master 16

1. Pumping in the gas.
2. Indirect uses of energy are: materials to make car; at the assembly plant; producing fuel at the well; repair and maintaining the car; highway construction.

3. 31%.
4. It takes more energy to run the car.

Classifying and Comparing Energy Use

If you prefer to add more student activity, you might want to do the following, in a kind of game:

Ask: I know a category where energy is used to straighten a bent fender. What is it? (Repair and Maintenance.)

I know a category where energy is used to make the plastic for the steering wheel. What is it? (Materials.)

I know a category which is more than twice the sum of all the others. Which is it? (Fuel.)

Ask students to think of other questions to add to the game.

THE ENERGY PUZZLE

Overview

The goal of this lesson is to provide students some information about the elements of energy production and consumption in the United States. This lesson informs students of the place of imported oil in the U.S. economy and leads them into activities that stimulate problem-solving. The impact of fuel shortage on the way people live is explored.

Objectives

Students should be able to:

1. Demonstrate that U.S. oil production does not match U.S. consumption.
2. Explain how imported oil must be used to meet the needs of U.S. consumption.

Materials

Puzzle pieces on oil consumption and production, to be cut out of Activity Masters 17, 18, 19

Time Allotment

One class period.

Activity	Procedure
	ACTIVITY MASTER 17 [redacted]
Experimenting and Hypothesizing	Ask students to cut out the puzzle pieces and fit them together. (If you prefer to add more challenge, duplicate enough pieces of the puzzle ahead of time and cut them out for the students.) The puzzle consists of two circles--one showing U.S. Energy Consumption; the other, U.S. Energy Production.
	Energy Consumption Circle
	(All pieces fit together and make a complete circle.)
	Energy Production Circle
	(The pieces for this circle represent only the U.S. oil production, and the full circle will become complete only if something

is added. What is it? The segment representing imported oil.) At this point, give each student the missing piece of the puzzle. Tell students that most of the imported fuel is oil, but some is natural gas.

Note: The master copy shows several pieces. This is intended to reduce the number of sheets of paper you might have to duplicate to have enough "missing pieces" for the entire class.

Computing Amounts

Inferring

Ask students to add up the percentage numbers on both circles. Make two separate columns of numbers. Which circle has enough numbers to total 100%? What percentage is still needed to make the other circle total 100%?

What percentage of oil consumption is imported? (Since oil consumption was 47% of the total, and imported oil 23% of the total, the United States imports 49% of its oil. (23 ÷ 47 = 46%.)

Problem solving

In order to reinforce the idea that the United States is using more energy from fossil fuels--mostly oil--than we are producing, you may want to create some choice-making situations:

You have a large garden. You want to live on the food you produce. What things would you have to think about in order to survive for a year? (How much can I grow? Will I have to eat only certain foods? What if I get sick and can't work in the garden? What if bad weather ruins some of the crops? Will I have to use some of the money I saved, but didn't want to spend just yet? And so on.) Let students think of as many possibilities as they can.

Ask: If there is a big demand for food because most gardeners did not grow enough, what, do you think, will happen to the price of food?

Try this situation on your students: Suppose you were on a camping trip with friends and everybody carried along his/her own food. If you ate all your food several days before the end of the camping trip, what could you do? (You could get food from the others, but they might charge you more for it, or trade their camp duties for it, like making you do their clean-up chores. Eat wild plants? Catch and cook a rabbit? What else?)

Compare these stories with the message of the circles on the rates of U.S. production and consumption of oil. Ask: Do we produce enough oil of our own? Since oil is a basic fuel found in nature, what might happen if everyone wants it, and the supply is limited? Can you think of some ways to make the supply last longer? (Conservation measures, look for more oil in other places; use alternative fuels.)

Remind students to keep their energy puzzle pieces in a safe place. They will use them again in Lesson 1, Unit 4.

Optional Activities

Interviewing

1. Enlist the assistance of parents to help students find out about the oil embargo of 1973. Report on the concerns and inconveniences of that winter. Deal with questions as:

   - How were people asked to conserve?
   - Why was the speed limit changed on the nation's highways?

- What were the lines like at the gas stations?
- What was the reason for the embargo?

Map Study

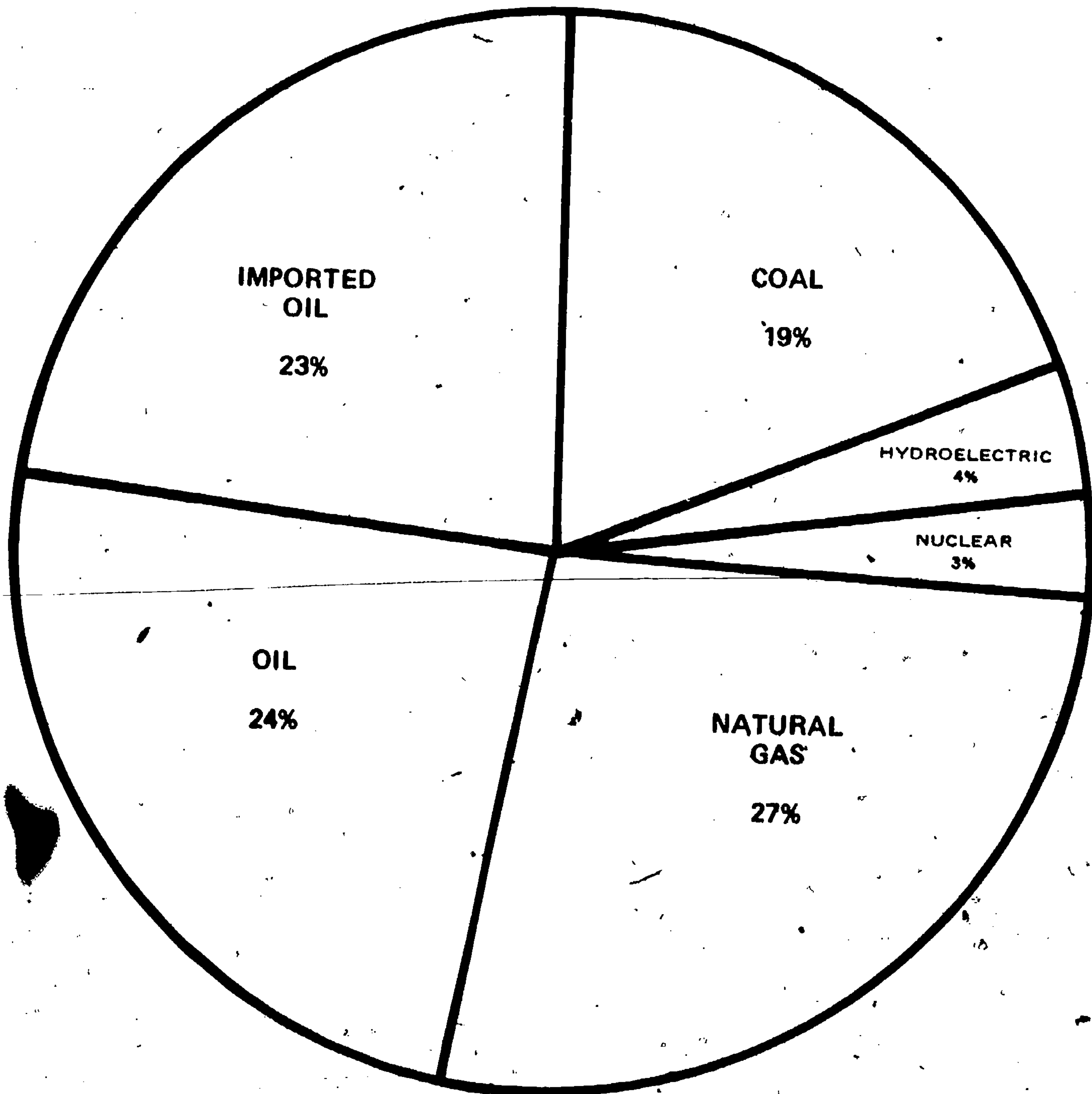
2. Ask students to use a world map and find the places where our oil imports come from.

North America---	Canada*
	Mexico
*South America---	Venezuela*
	Ecuador
	Trinidad
	Bolivia
Africa-----------	Algeria*
	Egypt
	Libya
	Nigeria*
	Angola
	Tunisia
	Zaire
	Gabon
Middle East-----	Abu Dhabi
	Iran
	Kuwait
	Saudi Arabia*
	Qatar
	Oman

* Major suppliers

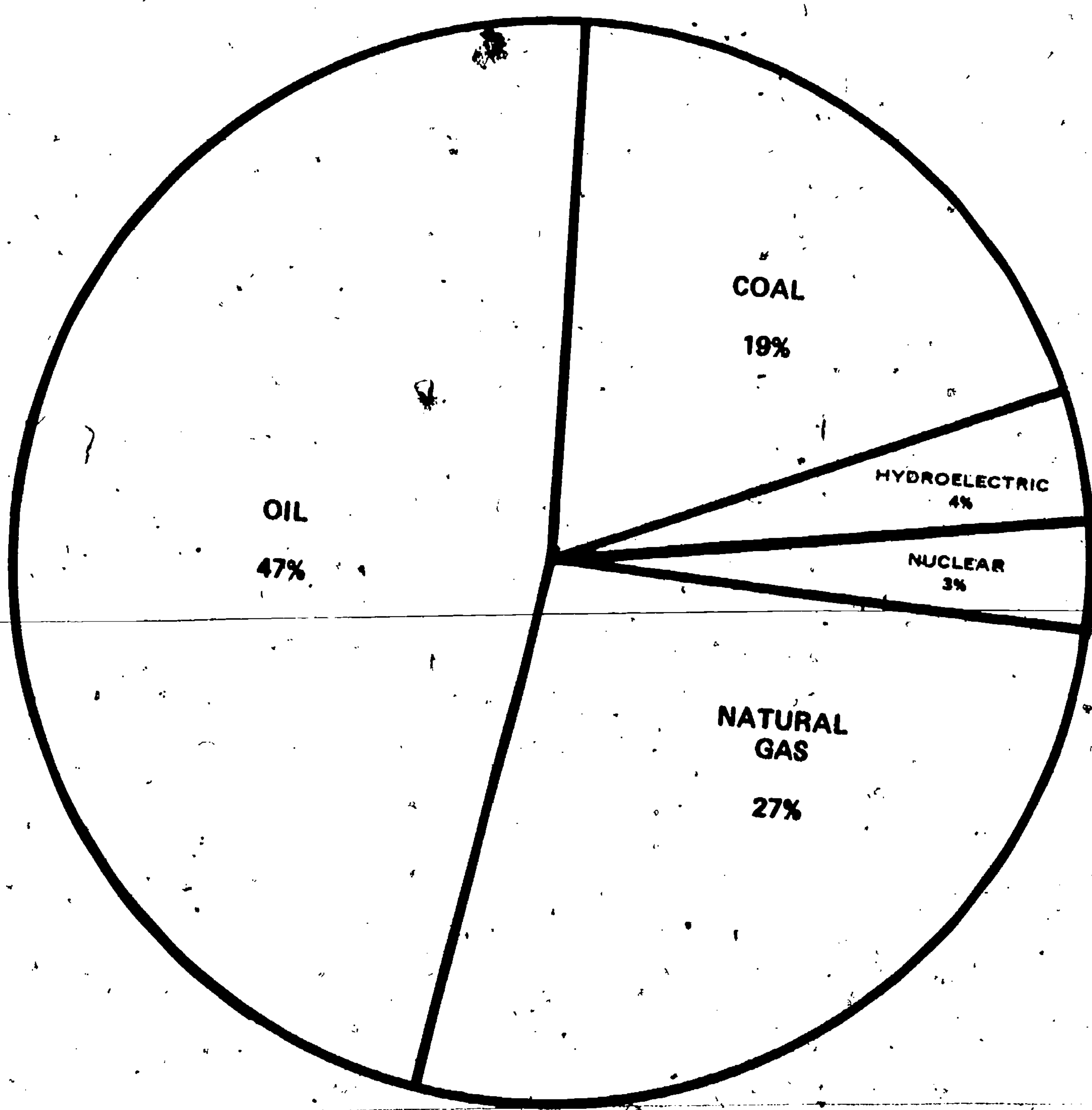
Teacher Use

U.S. ENERGY CONSUMPTION BY SOURCE



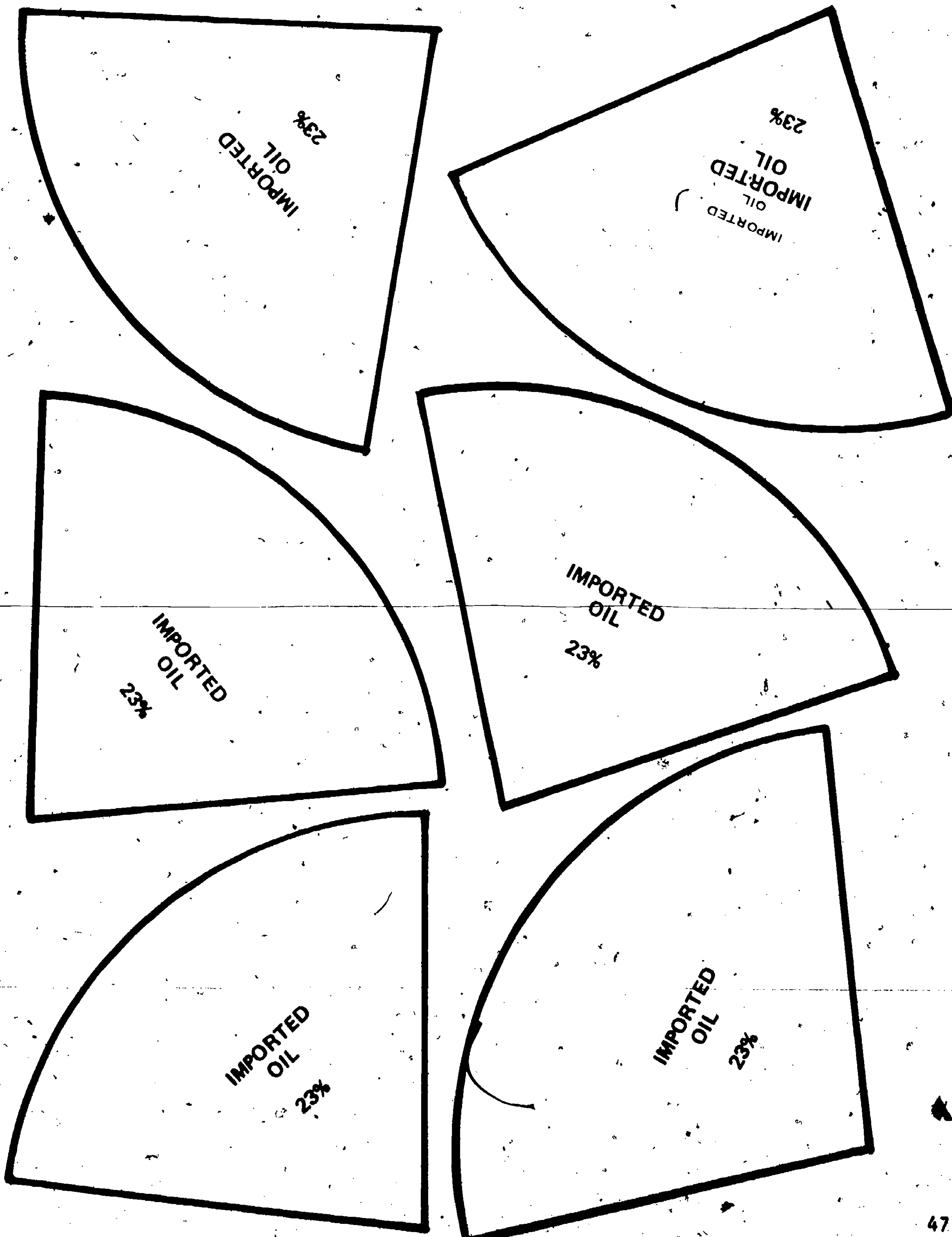
Teacher Use

U.S. ENERGY CONSUMPTION BY KIND



Teacher Use

IMPORTED OIL SECTORS - 1976



END USES OF ENERGY

Overview This lesson informs students of the relative sizes of the end uses of energy. The largest users are identified as the ones upon which conservation measures would have the greatest impact. One large energy user is transportation. Game-like elements provide data for students as they make simplified decisions about conserving energy in transportation.

Objectives Students should be able to:

1. Identify some of the end uses of energy.
2. Explain some of the ways energy can be conserved in transportation.
3. Estimate energy savings in a simulation.

Materials Student Activity Masters 20, 21

Time Allotment One class period.

Activity

Energy End Use----1975

Sector	Percent
Transportation	26.2
Space heating/cooling	20.9
Industrial Heat	26.4
Powered Machinery	8.2
Chemicals	5.1
Water Heating	3.8
Lighting	2.6
Refrigeration	2.4
Cooking	1.1
Other	3.3
	100.0

Procedure

The chart at left serves as the information source for students as they work out their activity sheets.

If the chart is written on the chalkboard, it might be helpful to let it remain on the board for the next day's lesson.

Allow sufficient time for the students to look closely at the data on the chart. Then ask the questions that follow:

1. In what categories is the most energy used? (Industrial heat and transportation.)
2. Give a specific example for each category heading. (Answers may vary.)
3. Which categories refer to the uses of energy in the home? (Water heating, Refrigeration, Cooking, Lighting, Space Heat-

ing/cooling.)

4. Which home energy user is the largest? (Space heating/cooling.)
5. Think of a week's time. In a week, from which two categories do you use a lot of energy? (Probably heating and transportation.)

ACTIVITY MASTER 20

[redacted]

This activity requires the use of the map of the Great Lakes region and ACTIVITY MASTER 20. The students are assigned the task of getting to the Silverdome from a certain city and computing the number of energy units it will take to get there by whatever travel mode they have chosen.

Begin the activity by assigning each student to one of the six cities below. Assign some students to Pontiac itself, at two different distances away from the stadium.

Detroit
Grand Rapids
Lansing
Toledo
Columbus
Cleveland
Pontiac (5 miles from stadium)
Pontiac (10 miles away)

Note: A Teacher Fact Sheet has been included. The fact sheet illustrates the energy units used in each method of transportation. See page 52.

Distribute copies of the map and Student Activity Master. Then ask students to complete the question sheets.

Conclude the activity by asking students to report on the method they used to get to the stadium on a set number of energy units. Did they find other ways to travel?

Discussion Points

You may wish to bring out the following elements regarding transportation and energy conservation:

1. Car efficiency (miles per gallon).
2. Location (distance from the stadium).
3. Use of mass transit.

How would traveling by bus or train all the time affect your life? How might it conserve energy?

Optional Activities

Play the game again. This time assign each student a different city. Repeat the procedure for figuring the energy units.

Have a small group investigate the public transportation facilities in their city. Make a report on how often the subway (or bus or train system) is used, and by how many people.

Transportation to the Stadium

Teacher Fact Sheet

Tabulated below are the energy units used by each method of transportation in traveling from each city to the Silverdome.

Transportation Information		Per Person Per Mile
Auto with one person	=	20 energy units
Auto with two people	=	10 energy units
Auto with five people	=	4 energy units
Bus with 44 people	=	1 energy unit

City	To Silverdome	Energy Units 1 Person Auto	Carpooling-Energy Units 5 Person Auto	Bus
Pontiac	5	100	20	5
Pontiac	10	200	40	10
Detroit	30	600	120	30
Lansing	64	1280	256	64
Toledo	91	1820	364	91
Grand Rapids	135	2700	540	135
Cleveland	197	3940	788	197
Columbus	232	4640	928	232

Cut-off line for a max of 700 units

A WEEKLY ENERGY BUDGET

Overview

In this lesson, students will become more aware of conservation measures that can be taken in the home. They will be exposed to the many different choices people have to make, some of which they may not have previously considered.

Objectives

Students should be able to:

1. Explain how conservation of energy involves choices.
2. Explain the relationship between modern life-style and growing energy demand.

Materials

Student Activity Masters 21, 22

Time Allotment

One class period.

Activity	Procedure
	Begin with a review of yesterday's lesson of the basic end uses of energy. Then explain the purpose of a household budget. Tell the class they are going to make a weekly energy budget. They must make some decisions regarding the conservation of energy in order to live within their means, meaning in this budget, energy units.
	ACTIVITY MASTER 21 - 22
	[redacted]
	Distribute the FACT SHEET (No. 21) and ACTIVITY MASTER 22. Allow sufficient time to go over the instructions.
	Tell the students that they must decide where to conserve energy in order to do all the activities for the week. (The numbers have been adjusted so that the only

way a person can do all the activities, both required and optional, as well as travel to work and maintain a home, is to conserve 30 units per week in the home.)

If he or she does not conserve at home, drives alone to work, and does only the required activities, he/she will use all of the 400 energy units allowed.

Special Note to the Teacher

The energy budget sets energy units in approximate proportion to the percentages shown on the end use of energy chart used in the previous day's lesson. You may want to look back at the chart.

Optional Activities

1. You may wish to change the number of energy units given to the class. For example, reducing 400 units to 300. This reduction makes the shortage more intense, if less realistic.

2. Challenge students to think of ways to conserve energy, such as bicycling to work or combining various activities. Have students be specific in mentioning which activities could be combined or in suggesting alternative methods of transportation.

3. Discuss the relationship of conservation and changes in lifestyle. Ask: Does taking part in fewer activities change your life? Explain.

A NEW WORLD OF ENERGY: SOLAR ENERGY

Overview

In this lesson, students will learn about using the sun's energy, the first of three alternative sources of energy examined in this unit. Previous lessons have shown that much of the energy used in a home (and in the stadium, for that matter) goes for heating and cooling devices. It takes energy to heat and cool your home, heat water, dry clothes, and cook food. If energy from the sun could do some of this heating, it would help to make our remaining reserves of coal, oil, and natural gas last longer.

Objectives

Students should be able to:

1. Explain the advantages and disadvantages of using solar energy for space heating and cooling.
2. Describe solar energy in relation to the needs of society, now and in the future.

Materials

Duplicated class set of the Fact Sheet No. 23 on Solar Energy, Activity Master 24.

Time Allotment

One class period.

Activity	Procedure
Hypothesizing	Re-introduce the oil production puzzle pieces from Unit III, and explore with students the basic experience of fuel shortages. Emphasize these shortages by having students take away three pieces of the puzzle--the imports section, gas, and oil. These represent the fossil fuels in most limited supply. Ask: Why can we let the piece for coal stay in?
Finding Facts to Support a Generalization	Distribute the FACT SHEET (No. 23) explaining the collection of the sun's energy. Have students read each fact on the sheet and decide under which heading on

Classifying

the ACTIVITY MASTER they will place the fact (summarized in a word or phrase.)

ACTIVITY MASTER 24

[redacted]

1. Have students draw lines from the source of energy to the place where it is processed.

2. Then draw a line from the processing place to society's energy needs.

3. Write words or brief statement under the headings: Advantages; Problems.

Note: You may want to give students a working definition of the words advantage and problem or disadvantage.

Encourage the students to list some facts under each heading.

Fact statements for connecting process to source and needs:

Solar collectors can provide space cooling.

The source of solar energy is the sun.

Solar collectors can provide hot water.

Homes and offices can be heated with solar collectors.

Fact statements showing advantages and disadvantages of solar energy.

The sun's energy is free.

It is expensive to store solar energy for use when the sun is not shining.

Solar heating systems require more expensive equipment than present heating and cooling systems.

We know how to harness solar energy now.

Optional Activities

Reporting

1. Ask students to do some research of the kinds of alternative energy sources--particularly solar collection--in their town. List the advantages and disadvantages of the devices.

2. Ask students to read articles on solar energy in the library. Report how solar energy can be used to save energy. Discuss and compare these readings.

Comparing

3. To compare scarcity to a familiar subject: ask students to list alternatives (vocabulary word) to writing paper that is in limited supply for the rest of the year. What could be used? (Students might mention using parts of unused paper, the back side of tablet paper, old pieces of construction paper, small, reusable slates, etc.)

For more details on alternative energy sources consult the Fact Sheets published by the National Science Teachers Association. Copies of the Fact Sheets may be obtained from Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, Tenn. 37830.

NEW USE FOR COAL: MAKING GAS FROM IT

Overview

In this lesson, students consider the possibility of producing gas from coal and the uses of this gas. The activity informs the student in much the same way as the previous lesson--Fact Sheet statements, and making a diagram connecting source to processing plant to the uses by people.

Objectives

Students should be able to:

1. Identify coal gasification as an alternative useful future fuel.
2. Compare the advantages and disadvantages of using gas made from coal.

Materials

Fact Sheet on Coal Gasification, No. 25
Activity Master 26

Time Allotment

One class period.

Activity	Procedure
	WORKSHEET, NO. 25-ACTIVITY MASTER 26
Classifying	This lesson moves in much the same way as the previous lesson. Students separate fact statements into two categories: 1. those statements that show advantages or disadvantages; and 2. those that will need to be illustrated by drawing lines on the ACTIVITY MASTER. These lines connect source to process to needs of people. Distribute the Worksheet and ACTIVITY MASTER. Instruct students to read the fact statements carefully. Then classify them as before into the two categories. Conclude by drawing appropriate connecting lines on the ACTIVITY MASTER.

Fact statements for connecting process to source and needs:

Coal is the source of energy for the process.

The gas from the process can be a source of chemicals for industry.

The gas from the process can be used to generate electricity for lighting, hot water and machinery.

The gas can be used to power automobiles and trains.

Gas from this process can be used for process heat and space heating and cooling.

Fact statements showing advantages and disadvantages of coal gasification:

We have the knowledge to do it now.

The coal supply will run out someday.

Coal mining causes environmental damage.

Processing coal this way can reduce air pollution.

Gas produced this way is more expensive than natural gas.

The supply of coal is large compared to oil and natural gas.

ENERGY FROM FUSING THE ATOM

Overview In this lesson, students look at the developments and promises of nuclear fusion. At the conclusion of this activity, they begin to compare the three energy alternatives for the future and make tentative generalizations regarding our future energy needs.

Objective Students should be able to identify nuclear fusion as a possible, abundant source of energy.

Materials Duplicated class set of Nuclear Fusion Fact Sheet, No. 27
Activity Master 28 - 30

Time Allotment One class period.

Activity	Procedure
	FACT SHEET, NO. 27 ACTIVITY MASTER 28 [redacted]
Classifying	Encourage students to use the FACT SHEET on nuclear fusion and the ACTIVITY MASTER for this lesson. Have students proceed as in Lesson 1 and 2.
	Fact statements for connecting process to source and needs:
	Electrical energy from the reactor can be used to power industrial machinery and to provide process heat.
	Electrical energy from the reactor can be used to power electric cars, buses and trains.
	The fusion reactor uses a nuclear fuel. (But not uranium.)

Electrical energy from the reactor can be used for space heating and cooling.

Electrical energy from the reactor can be used for lighting and hot water.

Fact statements showing advantages and disadvantages of nuclear fusion reactor:

These reactors will probably not be available for at least 20 years.

This technology will be very expensive to develop.

The fuel supply is essentially unlimited.

Using this electrical energy for cars will be difficult because we do not have adequate storage batteries.

There are many technical problems to be solved before we can build the reactor.

The fusion reactor has less troublesome (bad) waste products than nuclear fission reactors.

Concluding the lessons

Making Generalizations

Though students may not be able to understand all of the information on the FACT SHEETS, they should be aware that large alternative energy sources do exist or are just over the horizon and that the use of these fuels may allow existing supplies of traditional fuels to last longer.

The following guide questions for a wrap-up discussion should be placed on the chalkboard. Discuss each.

1. Looking back at our list of the needs of people, have we found an energy source for each need? (Yes) Students give examples.

2. Looking at the disadvantages listed for each alternative energy source--solar, coal gasification, nuclear fusion--were any disadvantages listed more than once? (Expense, different technology, not readily available.)

3. Which alternative energy source do you think has the best advantage, is the most attractive? Tell why. (Student opinion.)

4. How do modern industrial jobs depend on energy? How will they in the future? Explain.

5. How important is energy in providing comfortable living for people? How important is energy in leisure time activities? Explain.

ACTIVITY MASTERS 29 and 30

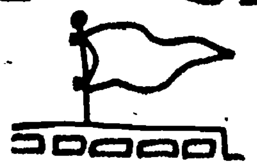
[redacted]

Problem Solving

Introduce the problem-solving activities in these masters by mentioning that these activities ask students to use what they have already learned in the packet. They should bring together some ideas about energy and the way people use it in making decisions.

Explain that the decisions chosen are theirs to make, but should correspond to ideas previously presented in the packet.

The ENERGY DOME

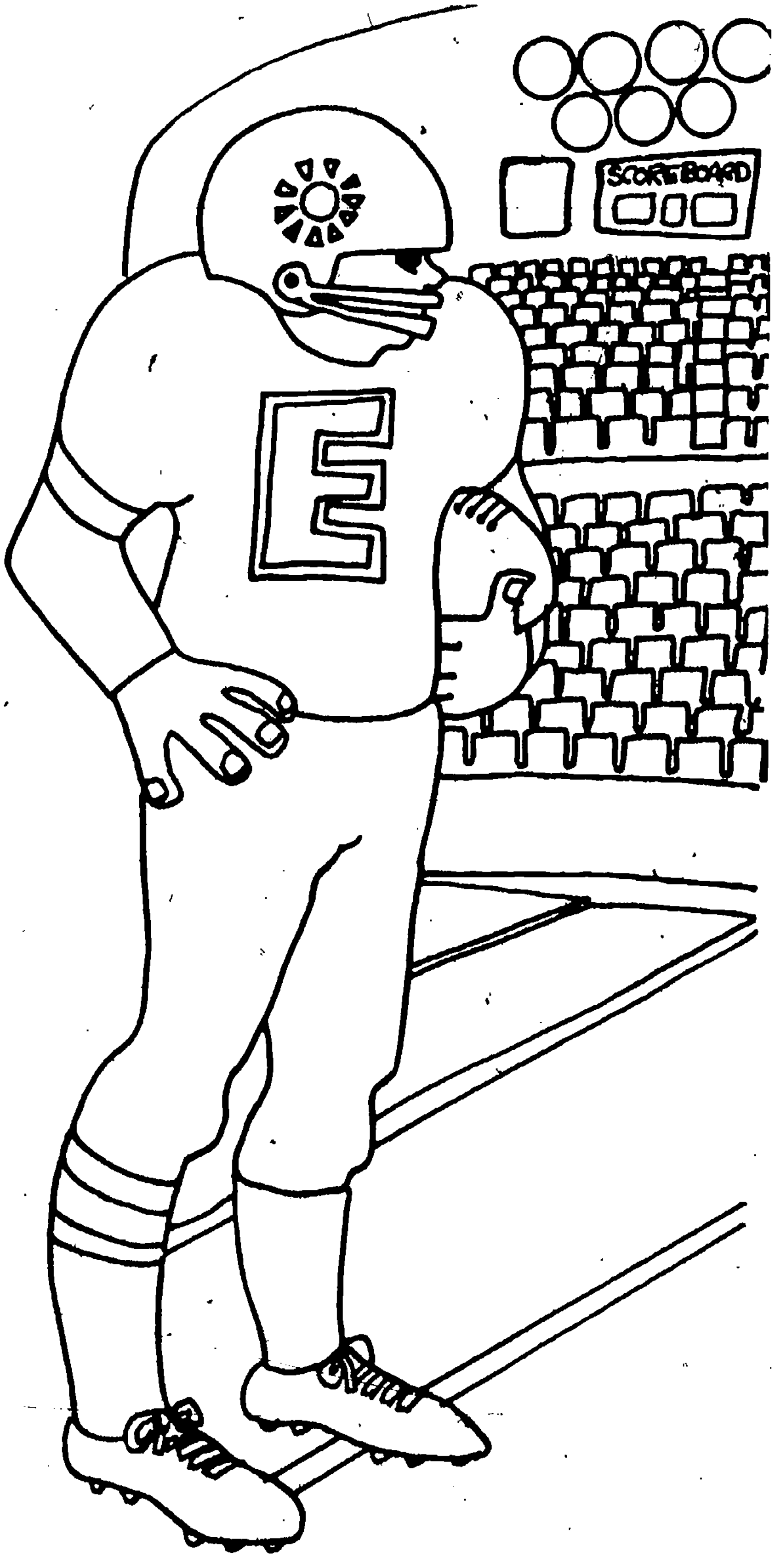


STUDENT ACTIVITIES BOOK

Direct Uses of Energy
Fossil Fuels

1

Here is a football player inside a domed stadium. Can you list what actions he might take that show muscle power? How can energy from coal, oil (gasoline, too), or natural gas, and electricity do the same things?



MUSCLE ENERGY

Running ______________________________

____

____

____

____

____

MECHANICAL ENERGY

Motor running ______________________________

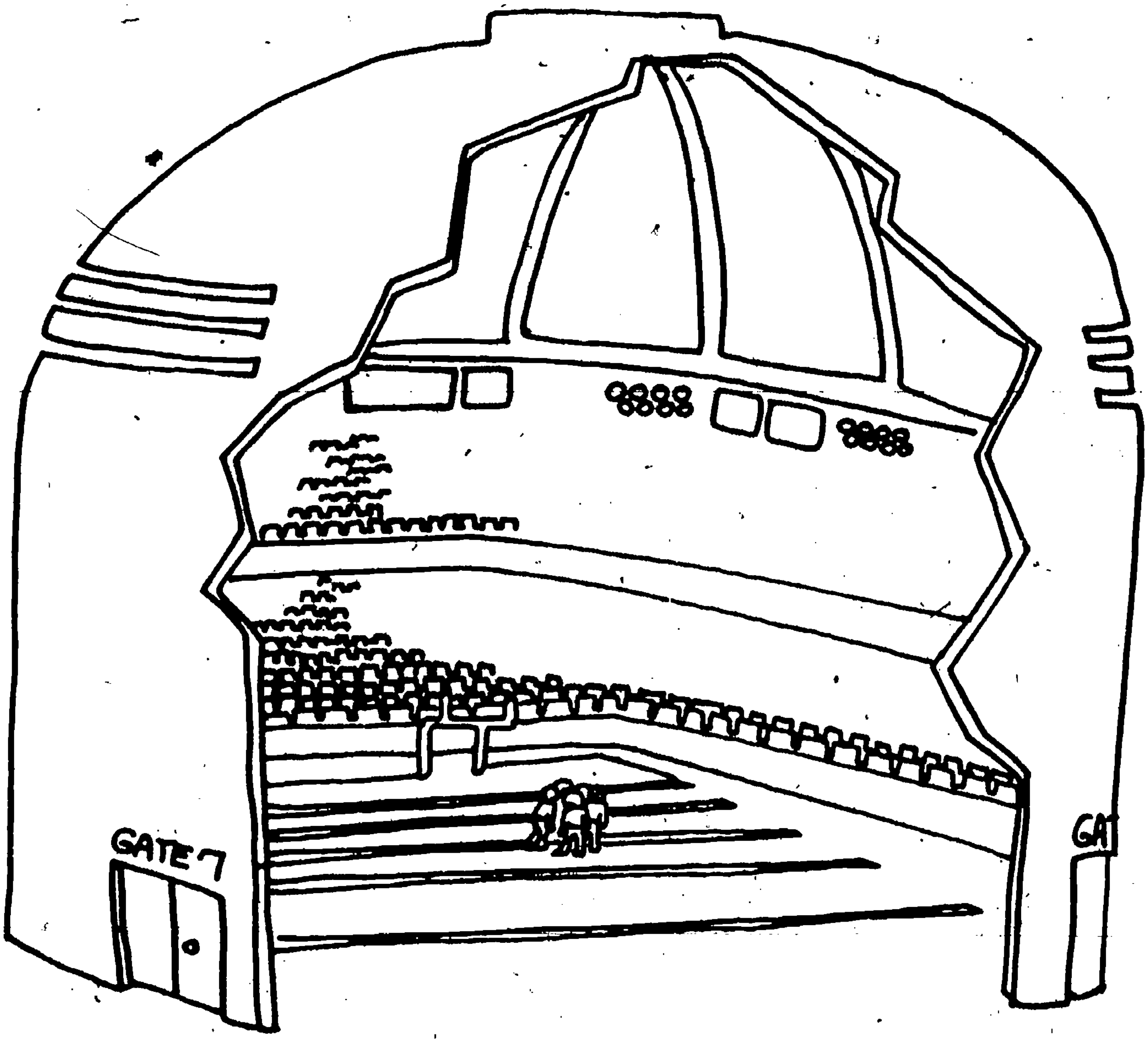
____

____

____

____

____



CAN YOU THINK OF THE ANSWERS TO THESE?

1. Write in the ways people get to the stadium.

2. What fuels are used for transportation?

3. Write in the ways you think energy is used in the stadium.

4. What fuels heat, light, and cook food in the stadium?

Did you think of everything? Compare your lists with a friend.

Tell why the domed stadium makes us "WEATHER-FREE". Is the climate-controlled shopping center like the domed stadium? Tell how these places depend on energy.

3

You can talk to people or write letters to find out how stadiums use energy. Use these questions and make up others as you need them.

1. What is the name of the stadium? ______________________________
____

2. What are the activities that go on in the stadium? __________
____
____
____

3. When is the stadium used? How often? ____________________
____
____

4. When was the stadium built? Was it built for a special reason?
Date:________________. Reason: ____________________________
____
____

5. How does the stadium use energy? Check the boxes.

☐ Lights ☐ Make water hot

☐ Heating ☐ Cook food

☐ Cooling ☐ People moving their muscles

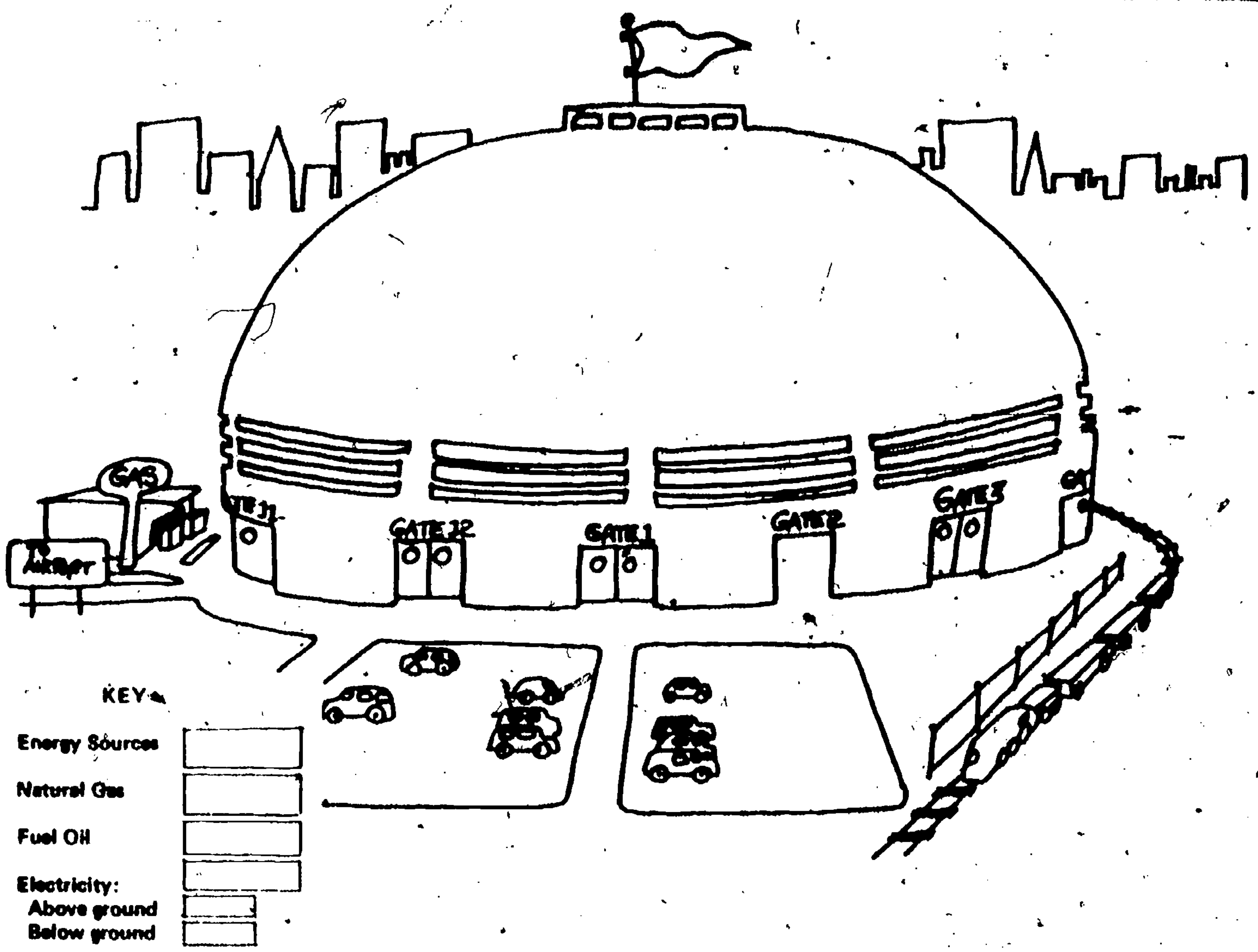
Write in other ways the stadium uses energy.

6. What forms of energy does the stadium use? Check them.

Electricity Fuel Oil

Natural Gas

7. Write in the ways people get to the stadium. ______________
____



There are many ways to get energy into the stadium. Unscramble the words below, answering each question with the words.

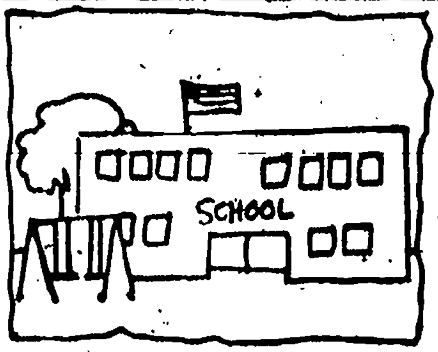
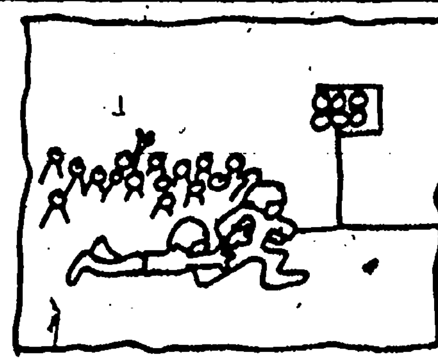
EELIPPIN How does natural gas get to the stadium?

ESIWR How does electricity get to the stadium?

KRUSTC What brings fuel oil to the stadium?

Draw a symbol for natural gas; something that stands for electricity; and something that represents fuel oil.

Can you find out what energy needs are required for a day at school? At home each day? For a night football game across town? Write what you find out here.

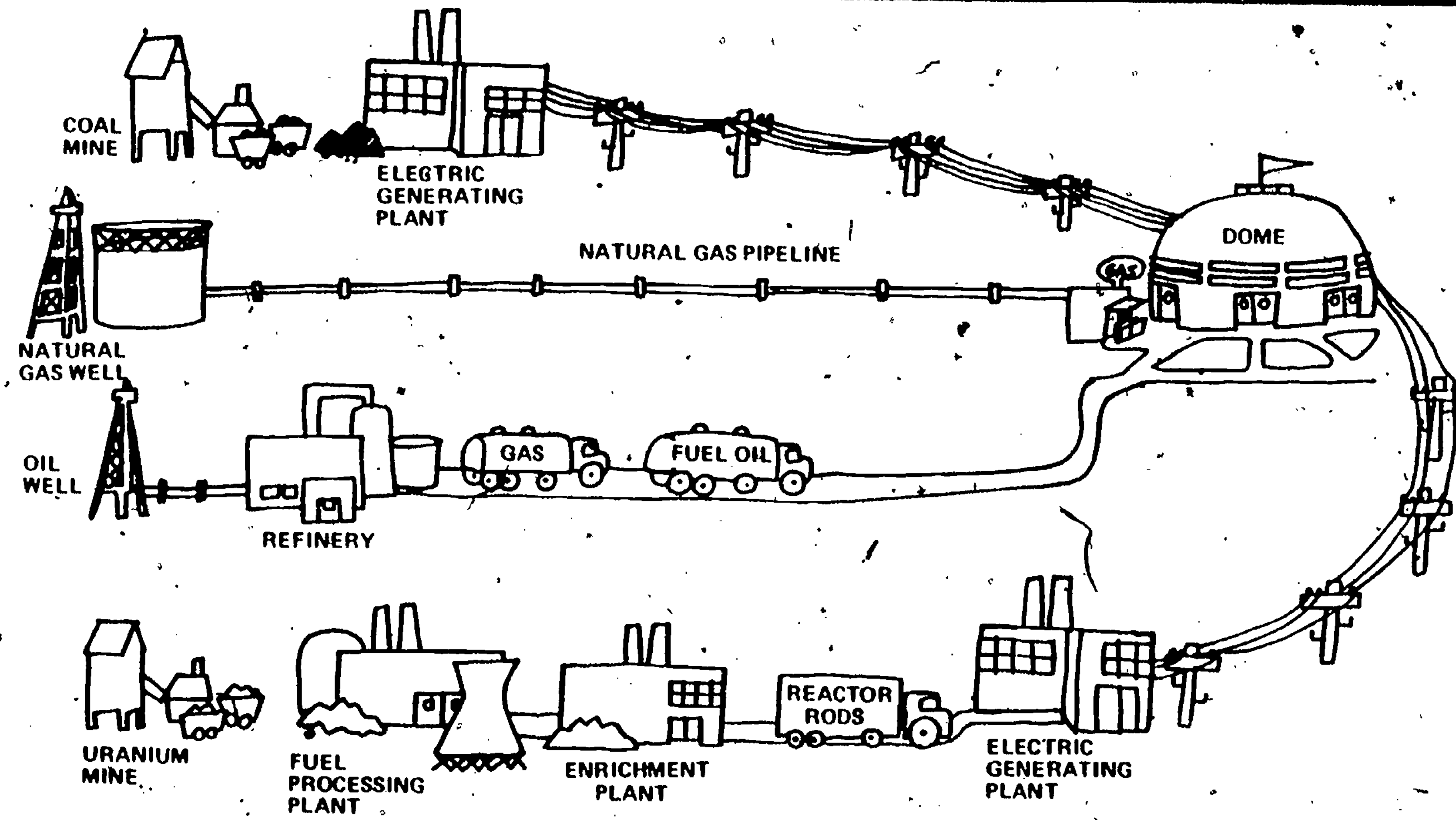
Energy Needs for a Day at School	Energy Needs for a Day at Home	Energy Needs for Night Football Game Across Town
		

89

Decide where the energy routes are into the stadium. You may draw symbols for energy forms and draw the routes to the Energy Dome.

Use the space below to draw a map showing your neighborhood. Use symbols and route lines to show how energy gets to your neighborhood.

Producing and Moving Energy



What four basic resources provide energy to the stadium?

1. ______________________ 3. ______________________

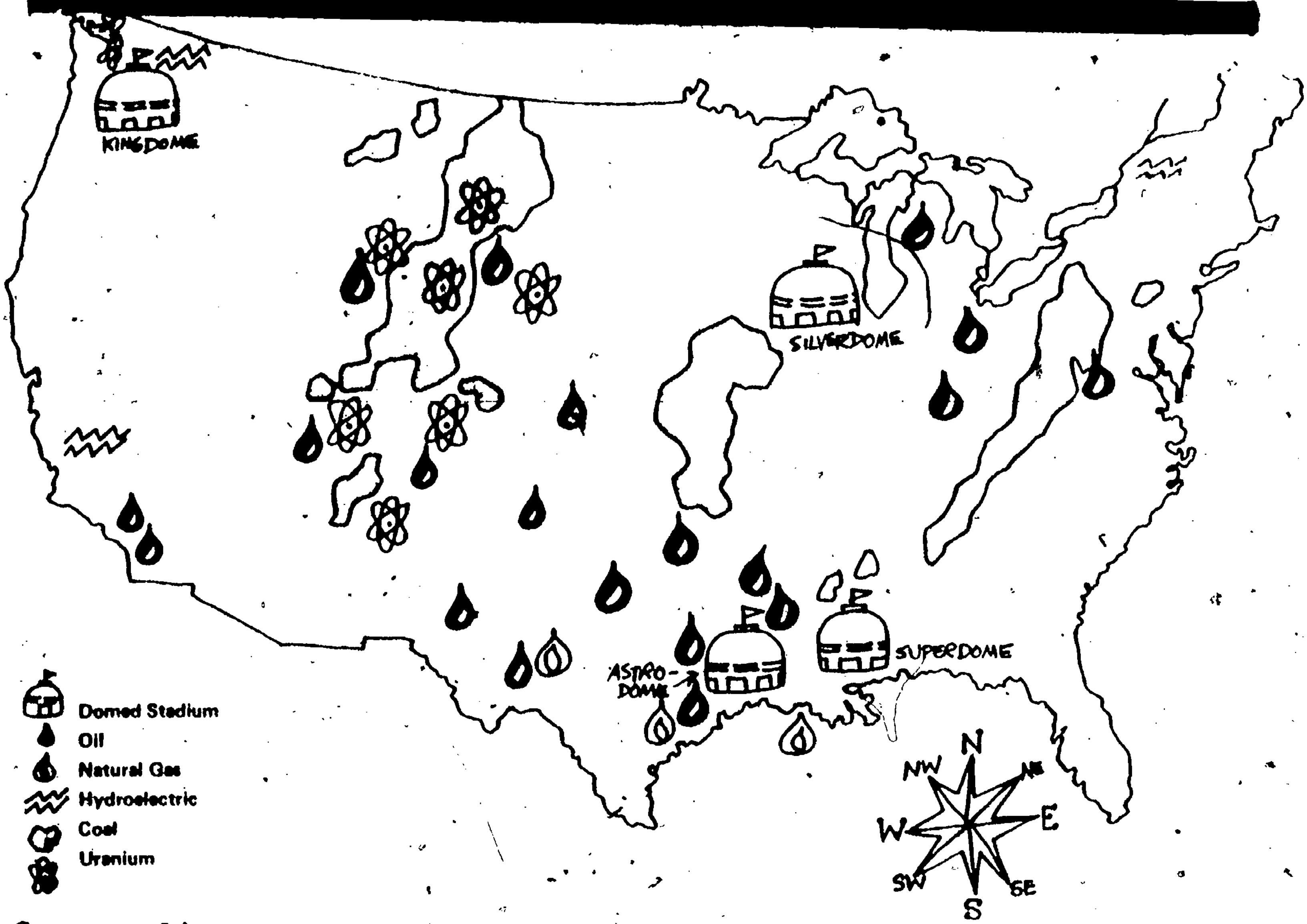
2. ______________________ 4. ______________________

Which resource has the fewest processing steps? ______________________

Which two resources have to go through an electric generating plant?

1. ______________________ 2. ______________________

Where is oil processed? In the ______________________.



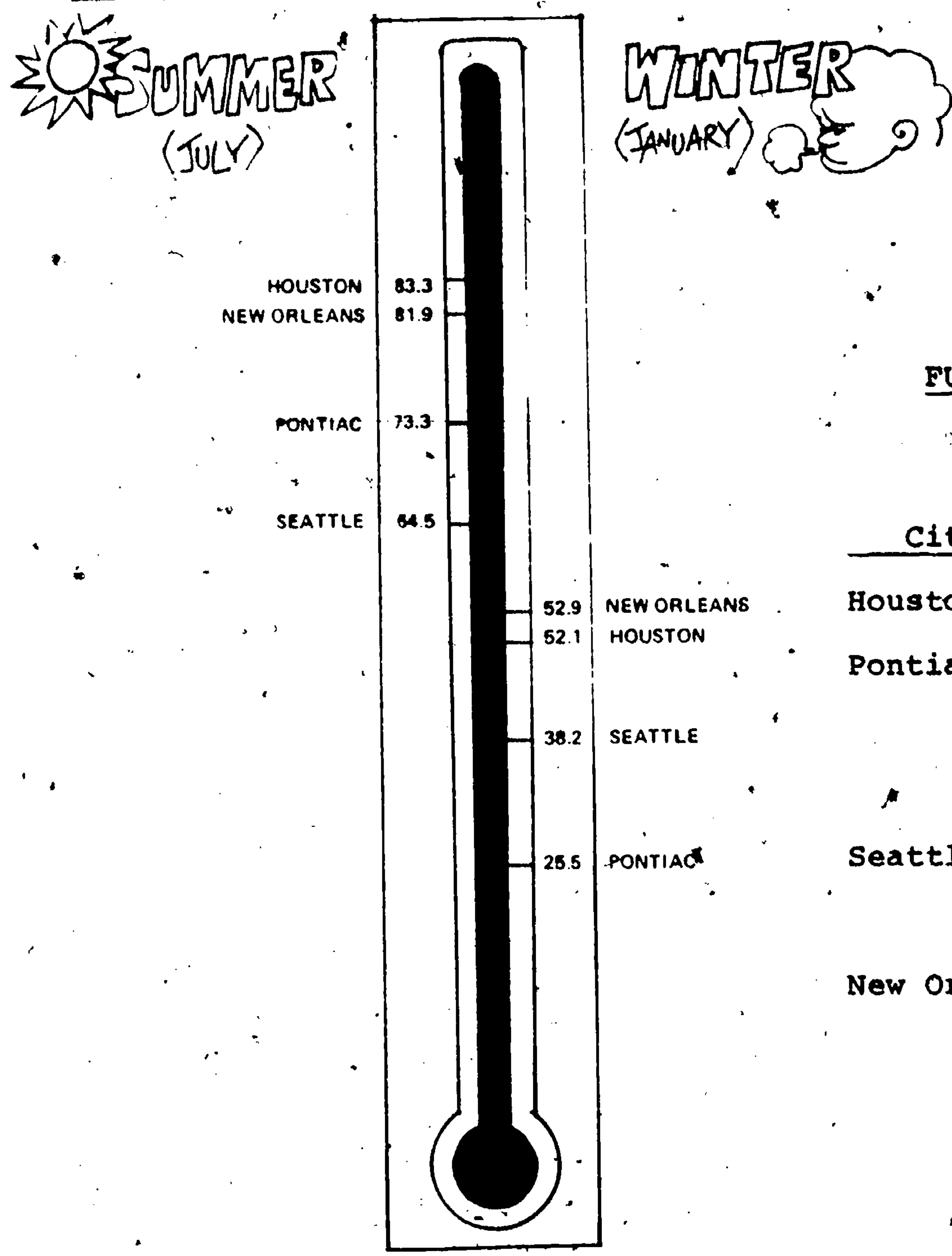
Can you list the domed stadiums? Which one would you see in ~~these~~ cities?

		Teams
Houston, Texas	____________________	________________
Pontiac, Michigan	____________________	________________
Seattle, Washington	____________________	________________
New Orleans, Louisiana	____________________	________________

Write in the name of each home team for the stadiums. Which team has an <u>energy</u> name? ____________________

Which stadiums have large energy resources around them?

____________________ and ____________________



Average Monthly Temperature

FUEL SOURCES FOR DOMED STADIUMS

City	Major Source of Electricity	Major Source of Heating Fuel
Houston	Gas	Gas
Pontiac	Coal, Uranium, Oil	Fuel Oil, Gas
Seattle	Hydro, Coal	Gas
New Orleans	Gas	Gas

1. What is the average daytime temperature in Seattle in July?
2. Which city probably has cold Januarys?
3. Which two cities have similar summertime temperatures?
4. Which stadium would probably have the highest heating bill?
5. Which stadiums would have high air-conditioning bills?

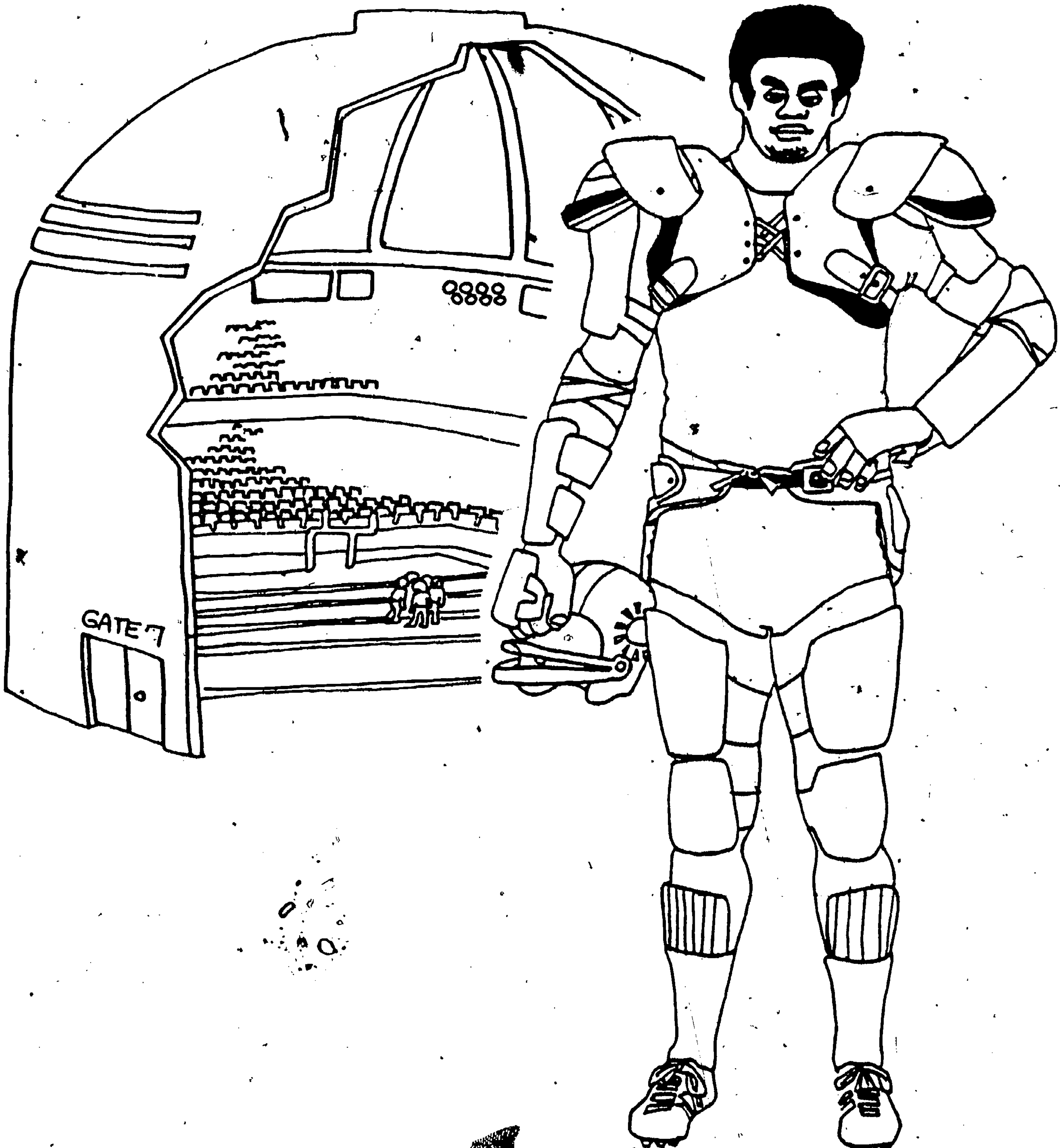
Can you list five different sources that can be used to make electricity to keep us warm--or cool?

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________

Indirect Uses of Energy
Fossil Fuels

2

Can you find all the products made from plastic? You can work with a friend. Make your lists on your own paper.



Read here of how plastic products began in the United States. Read about other plastic products and write the history of one in the space.

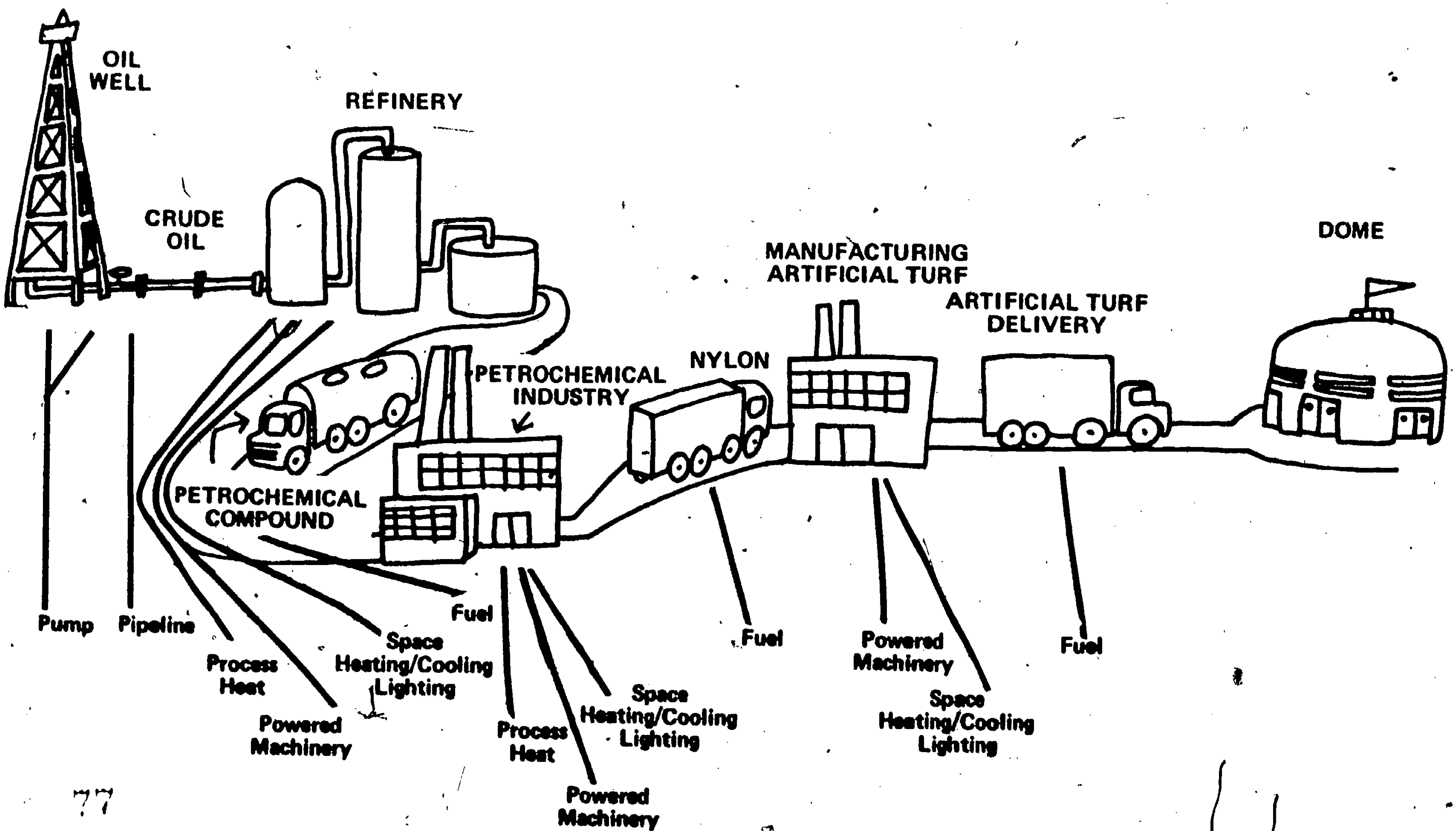
The First Plastic

In creating the first commercial plastic in the United States in 1868, John Wesley Hyatt did so in response to a competition sponsored by a manufacturer of billiard balls. It came about when a shortage developed in ivory from which billiard balls were made. Hyatt, a determined full-time printer and part-time inventor, developed Celluloid.

Celluloid, the first American plastic, was soon found to have many uses. It was used as a replacement for hard rubber in false teeth. It was the material from which wipe-clean collars, cuffs, and shirt fronts were made, and it made the window curtains on early automobiles. The first photographic film used by Eastman was made of celluloid in the 1880's to make the first movie film in 1882.

<u>The Story of the Plastics Industry</u>, by Don Masson.

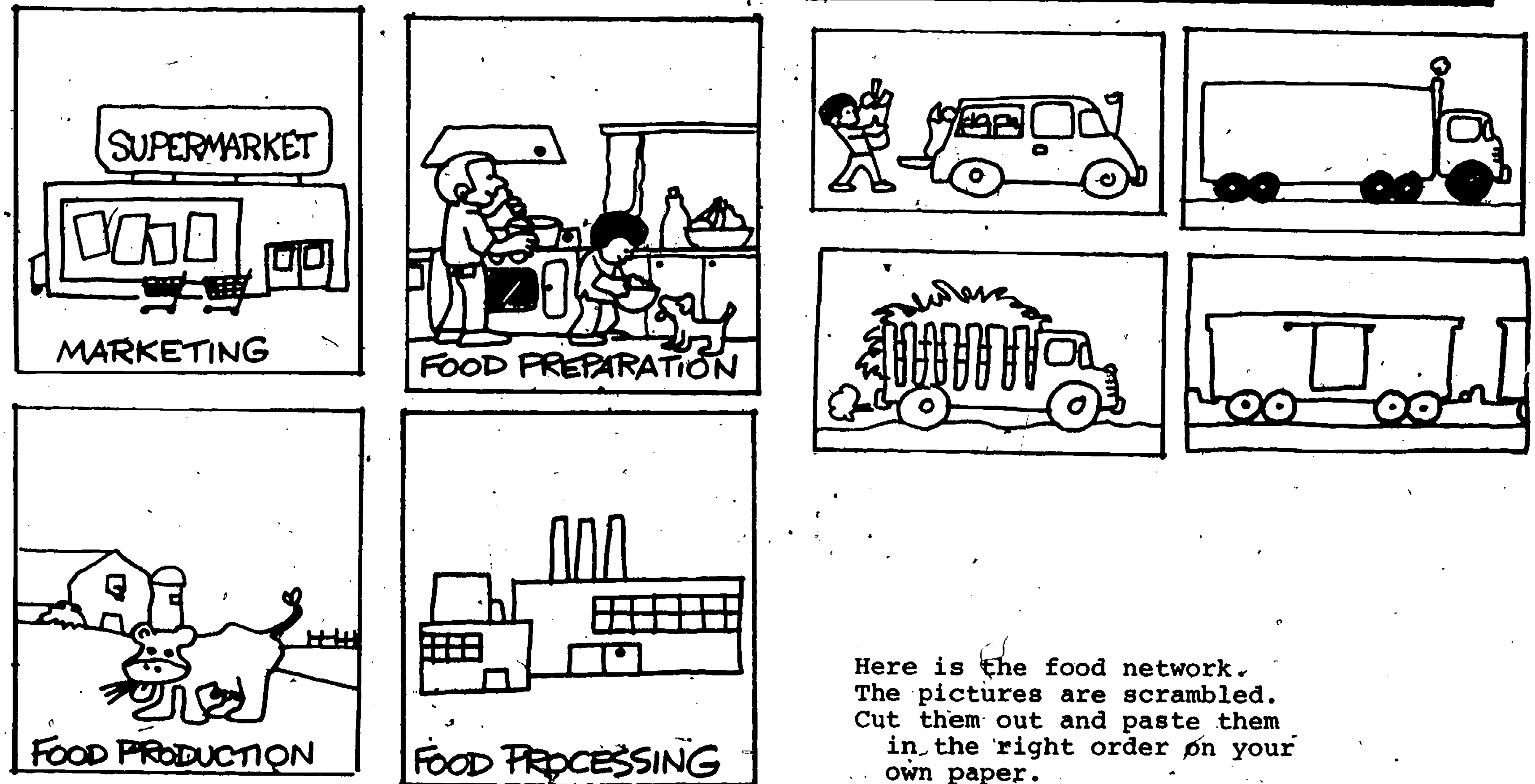
OIL to TURF: AN INDIRECT ENERGY NETWORK



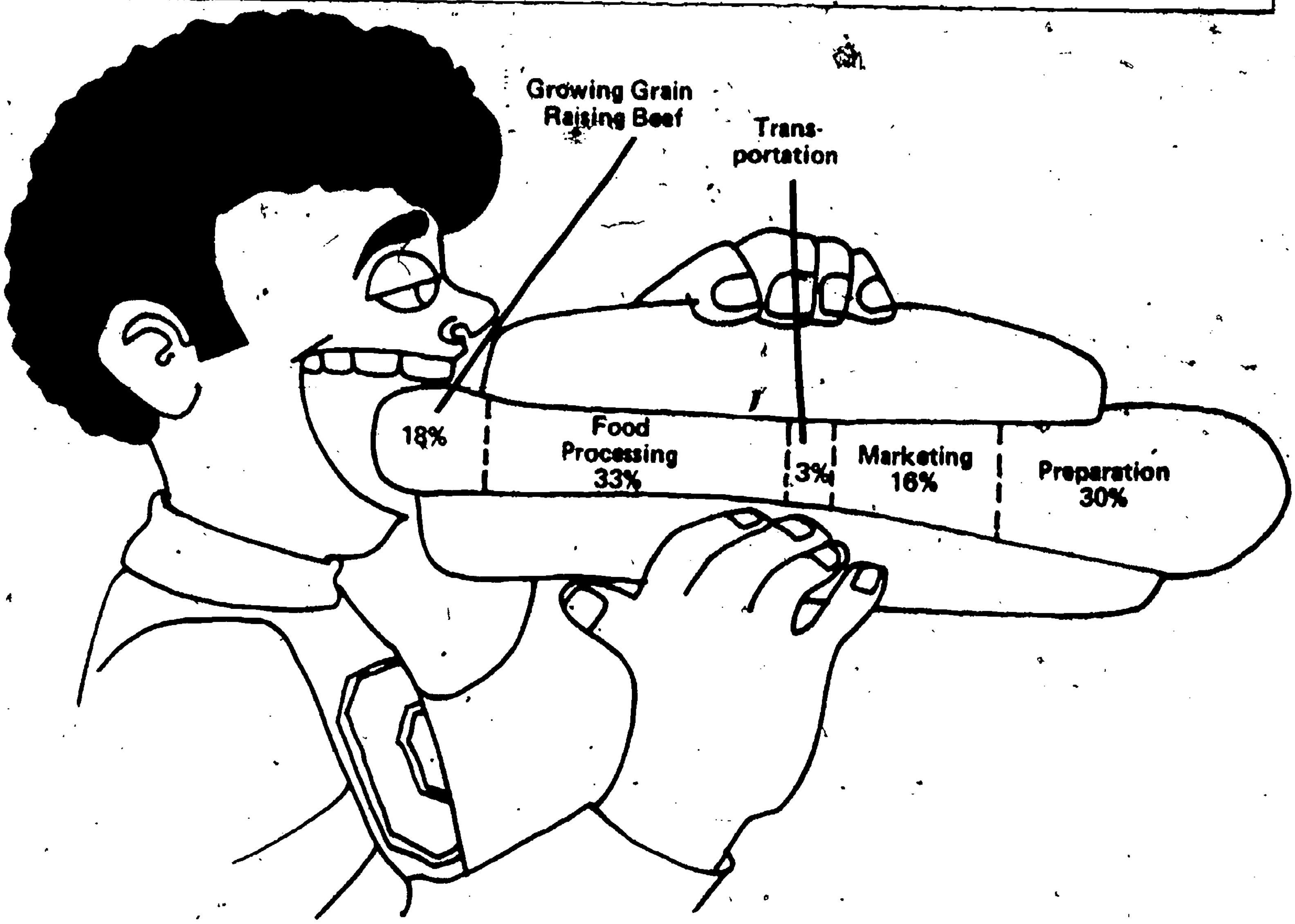
77

How is artificial turf made from oil? Write a story about it. Use your own paper.

ENERGY STEPS in the FOOD CHAIN



Here is the food network.
The pictures are scrambled.
Cut them out and paste them in the right order on your own paper.
Then draw in roads and add the cars, trains, and trucks to your picture.
Use your pencil to circle the places where energy is used.



Study the picture above. Explain in your own words what each of the words mean.

Food Processing. ______________________

Marketing. ______________________

Preparation. ______________________

Growing and Raising. ______________________

Transportation. ______________________

What part of the food network uses the <u>most</u> energy? ______________________

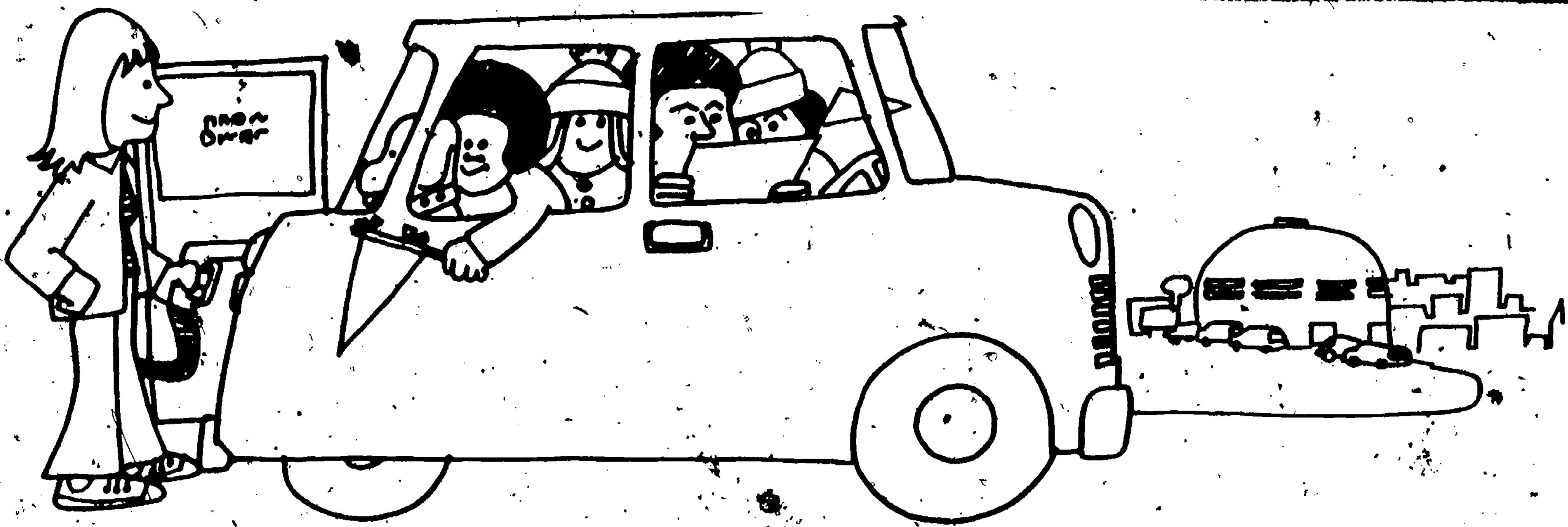
____

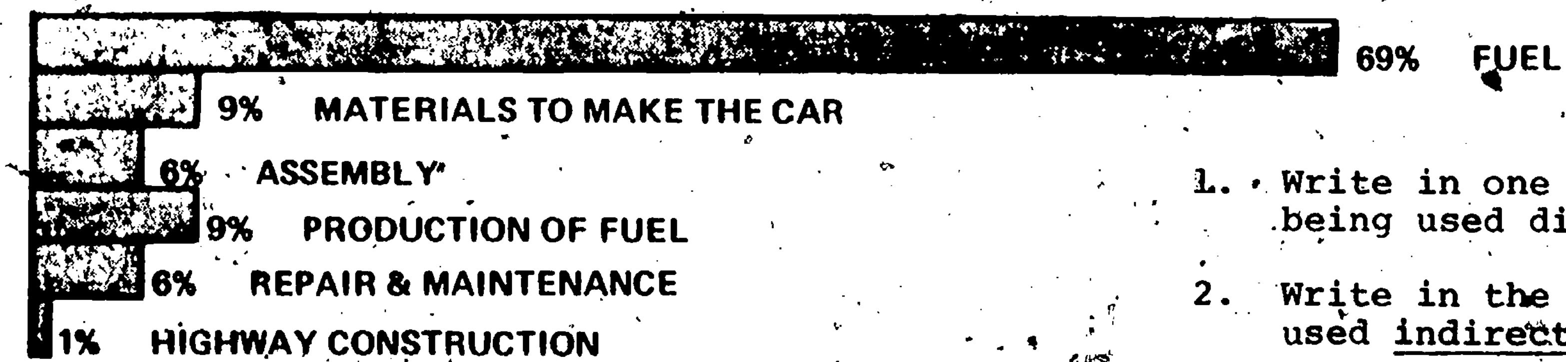
What part ranks as the second largest user? ______________________

Which uses the smallest amount of energy? ______________________

If you go to the stadium by car... where does the energy go?

16





1. Write in one place where energy is being used directly.

2. Write in the ways energy is being used indirectly.

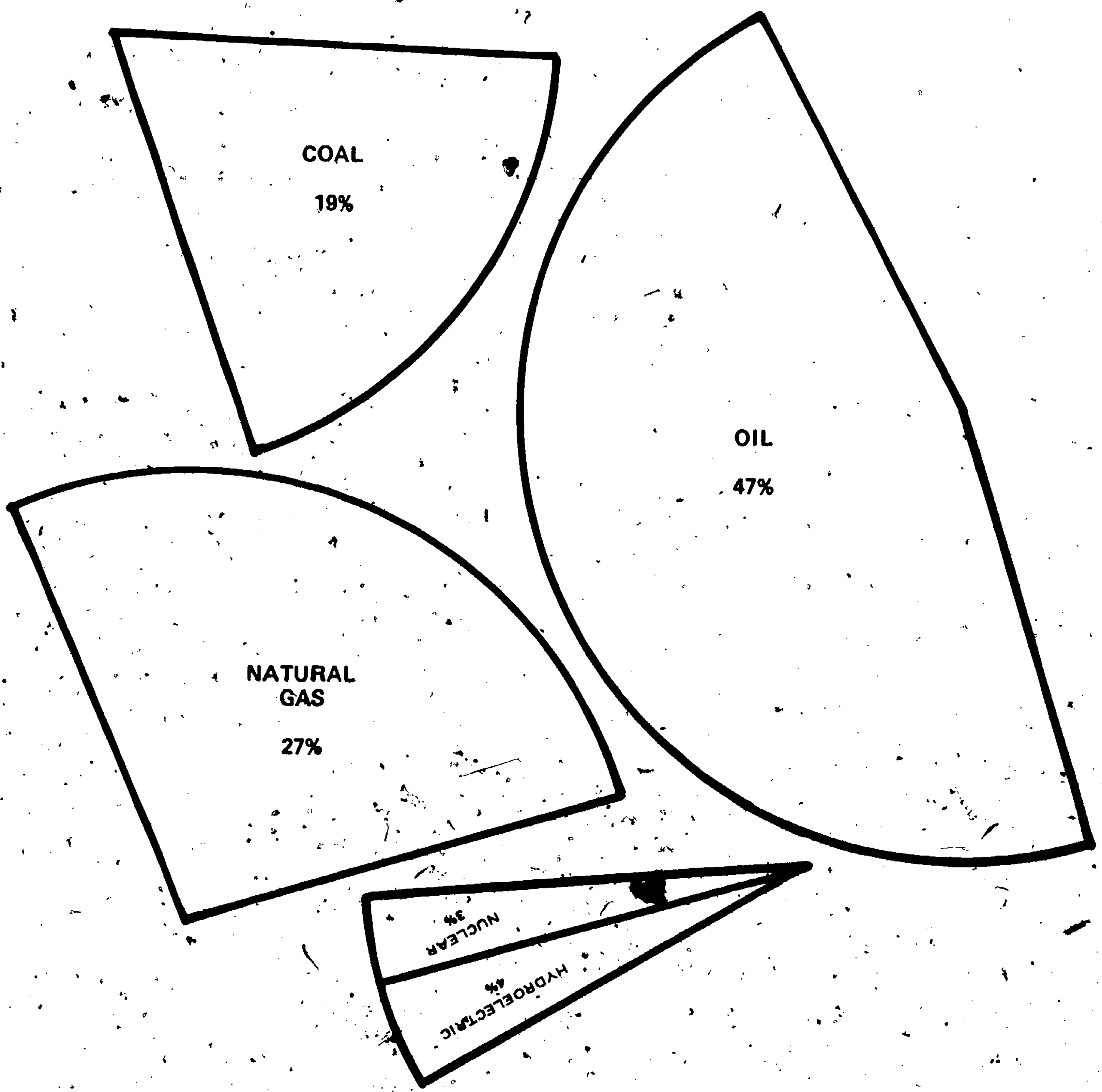
3. Add up the percentages of indirect energy uses. What is the total?

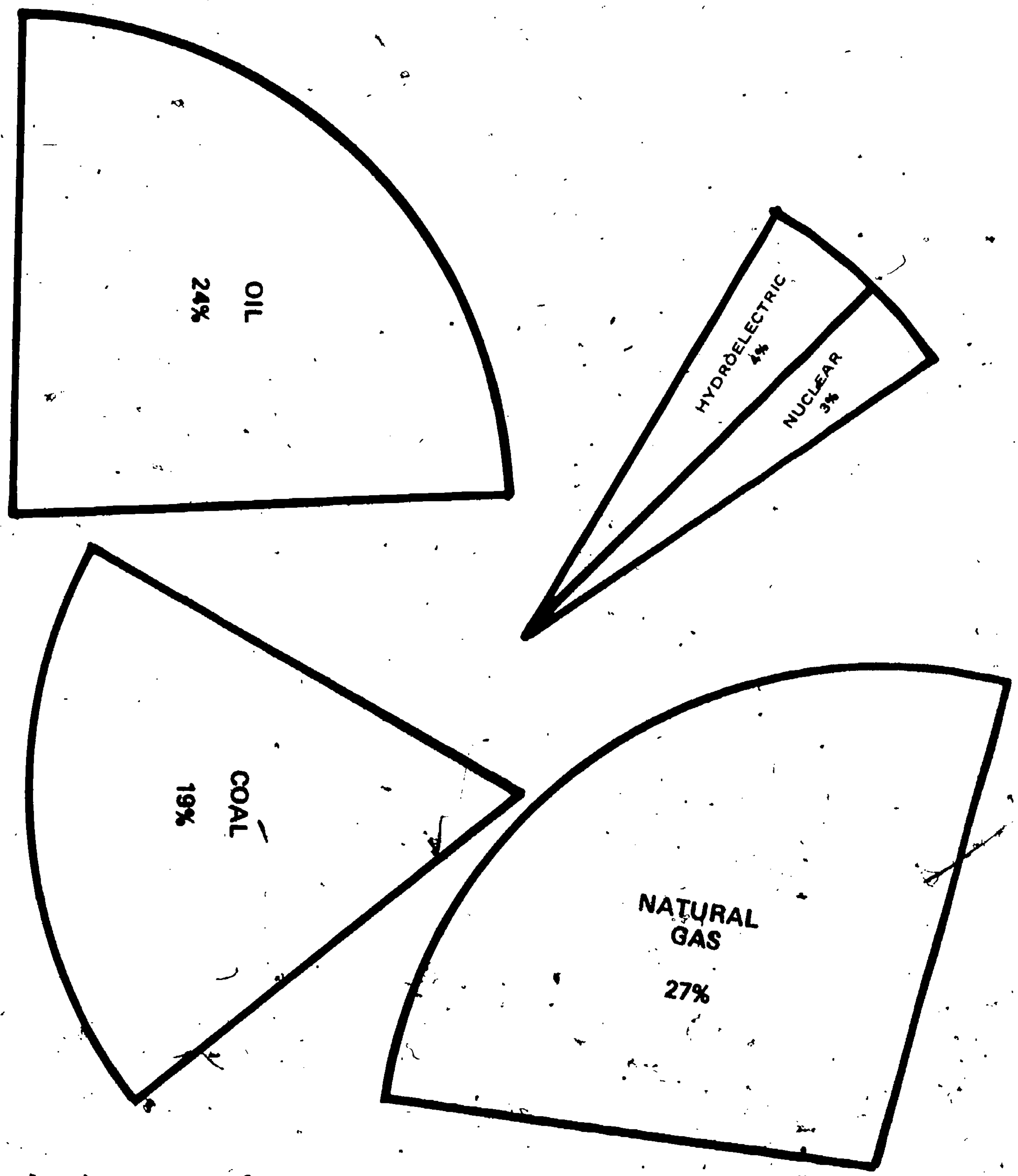
4. Compare direct and indirect uses. Which uses more energy--running the car or making the car?

Conservation of Energy

3

U.S. CONSUMPTION CIRCLE - 1976




OIL
24%
HYDROELECTRIC
4%
NUCLEAR
3%
COAL
19%
NATURAL
GAS
27%

After you have put the two puzzles together, answer these:

1. Write in the numbers on the pieces for each circle. (Be careful. Do not mix the pieces from one circle to another.) Add the numbers. If the numbers do not total 100%, find out how much is missing.

U.S. Consumption	U.S. Production
______	______
______	______
______	______
______	______
______	______
Total ______	Total ______

2. Each circle should have the same amount of each fuel. What is missing? ______________________

3. Write in the place where you think the missing fuel comes from.

____

4. Write in your own words the meaning of "import".

____

5. List five ways Americans use oil.

______ ______ ______

______ ______

6. Think of a way to conserve oil. Write your idea in the space below.

Note: Keep your puzzle pieces. You will need them later.

GOING to the SILVERDOME

To complete this activity you need:

1. The map of the Pontiac region.
2. The travel information given below. Fill in the blanks.

Travel Information		Per Person Per Mile
Auto---One Person	=	20 energy units
Auto---Two People	=	10 energy units
Auto---Five People	=	4 energy units
Bus----44 People	=	1 energy unit

Your city is ______________________________ (ask your teacher).

It is ____________________________ miles from Pontiac (map).

You have 700 units to use for transportation to get to the stadium.

Your assignment is to get to the stadium.

Answer These:

1. How many units does it take to go by yourself in a car? (Miles to travel multiplied by the correct number of energy units per mile given above.) ______________________________
2. Do you have that many? ______________________________
3. How many units do you use if you share a car with a friend? ________________________ How many units do both you and your friend use? ______________________________
4. How many do you use if you take four friends? ____________
5. How many units do you use if you take the bus? ____________
6. How should you travel to the stadium to save the most energy units? ______________________________

7. How many different ways can you travel to the stadium without going over your 700 limit? ______________________________

8. Could you go to the stadium more than once? ______________

9. If you take four friends how many energy units do you save compared to going by yourself? ______________

10. Can you think of other ways to go to the stadium? ______________

11. Why might you prefer to drive your own car? ______________

12. Why might taking a bus be a good idea? ______________

DISTANCES FROM MAJOR CITIES TO PONTIAC SILVERDOME
WISCONSIN
MICHIGAN
CANADA
MONTREAL 615 MI.
TORONTO 255 MI.
GRAND RAPIDS 135 MI.
LANSING 64 MI.
FLINT
PORT HURON
PONTIAC
MILWAUKEE 411 MI.
BUFFALO 282 MI.
DETROIT 30 MI.
ANN ARBOR
NEW YORK
CHICAGO 301 MI.
TOLEDO 91 MI.
NEW YORK CITY 697 MI.
CLEVELAND 197 MI.
PENNSYLVANIA
INDIANA
OHIO
PITTSBURGH 315 MI.
ILLINOIS
COLUMBUS 232 MI.
INDIANAPOLIS 304 MI.
CINCINNATI 285 MI.
LOUISVILLE 397 MI.
KENTUCKY

You have 400 energy units for all your activities this week. Using these units, you must (1) maintain your home, (2) travel to and from work and (3) provide transportation energy for all your other activities.

Energy Units	
Heat	20
Hot Water	4
Lights	2
Refrigerator	2
Cooking	2
Total	30

1. If you cook and bathe regularly and set your thermostat at 70 F, your home requires 30 energy units per day as shown. If you set your thermostat at 65 F, you require only 25.

2. You have three choices for traveling to work 5 days per week:

Drive by Yourself	30 units per day
Car Pool	10 units per day
Bus (with 15 min. walk)	7 units per day
Bike	0
Walk	0

3. It is necessary for you to go to the doctor, the grocery store, a scout leaders' meeting and the hardware store. Each trip requires 10 units.

Doctor---------------------10 units
Grocery--------------------10 units
Scout Leaders' Meeting------10 units
Hardware Store--------------10 units

4. Other activities you might like to do this week are listed below with their required energy units.

Activity	Energy Units
Dinner at Restaurant	10
Visit Friend	5
Soccer Practice	10
Movie	30
Shopping Center	10
Game at Stadium (also on television)	80

MY ENERGY BUDGET

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4	5	6	7
Home ______	Home ______	Home ______	Home ______	Home ______	Home ______	Home ______
Activities ______	Job ______	Job ______	Job ______	Job ______	Job ______	Activities ______
	Activities ______	Activities ______	Activities ______	Activities ______	Activities ______	
Daily Total ______	Daily Total ______	Daily Total ______	Daily Total ______	Daily Total ______	Daily Total ______	Daily Total ______

Using the fact sheet, make your energy budget for one week.
First, determine the energy units needed for your home.
Then choose the way you travel to work, and find the week's total.
Choose the optional activities you want to do.
Add all the numbers.
If your total is <u>less</u> than 400, you can add activities and turn up the thermostat. If your total is <u>more</u> than 400, you must adjust your energy budget.

Conservation

List five ways you have tried to save energy.

Tell some of these to the class.

Extra Activities

4

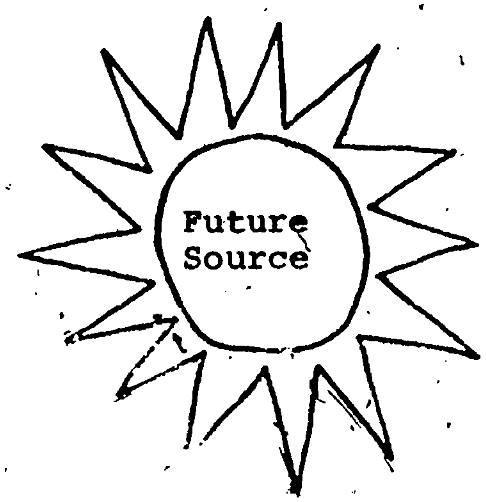
Read each fact statement below.

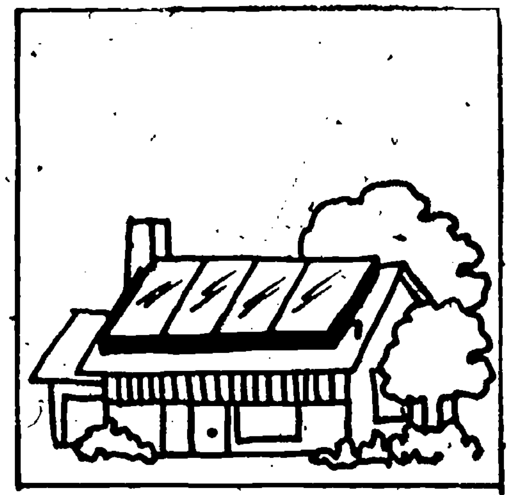
Decide if the statement shows how solar energy is collected and used by people. If so, draw lines on the ACTIVITY MASTER from the sun to the collector to the needs of people.

Some statements are saying something about the advantages of using solar energy, or about disadvantages using solar energy. These statements should be written in the proper lines of the ACTIVITY MASTER.

FACTS

- Solar collectors can be used for cooling homes.
- The sun's energy is free.
- We know how to use solar energy now.
- Solar collectors can be used to make water hot.
- The source of solar energy is the sun.
- It is expensive to store solar energy and use it later when the sun is not shining.
- Solar heating systems are more expensive than ordinary furnaces and air conditioners.
- Solar collectors can be used for heating homes and offices.
- In northern cities in the United States, solar collectors may not be able to provide all the energy needed for space heating.

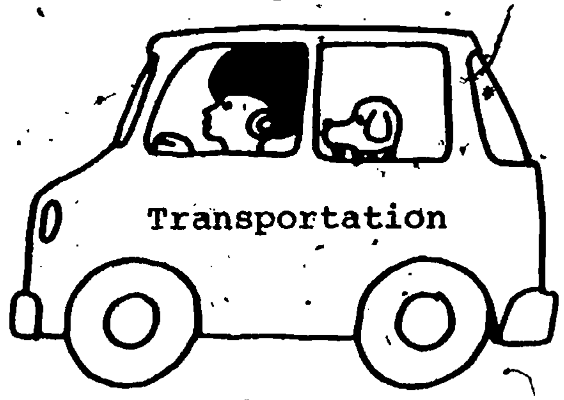




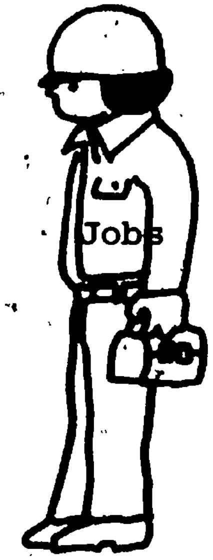
SOLAR COLLECTOR

Needs of People

Space heat
Space cooling.
Lights
Make water hot



Automobile
Bus
Train



Machinery
Process heat
Chemical materials
Space heat
Space cooling
Lights

Advantages:

Disadvantages:

Draw a line from the sun to the collector to the need the sun satisfies.

Go back and look again at the FACT SHEET about Solar Collectors. Then find a statement that shows how the sun's energy is collected and used for some purpose by people. Draw a line to show this flow. Then find another fact statement and draw another line. And so on.

Compare your picture with a classmate's.

Read each fact statement below.

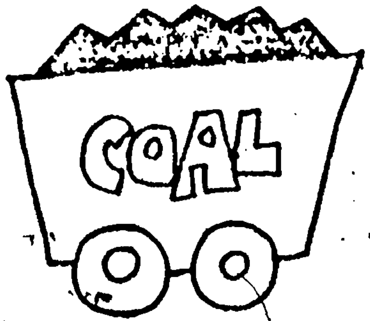
Decide if the statement shows how methane is made from coal and used by people. If so, draw lines on the ACTIVITY MASTER from the coal car to the coal gasification plant to the needs of people.

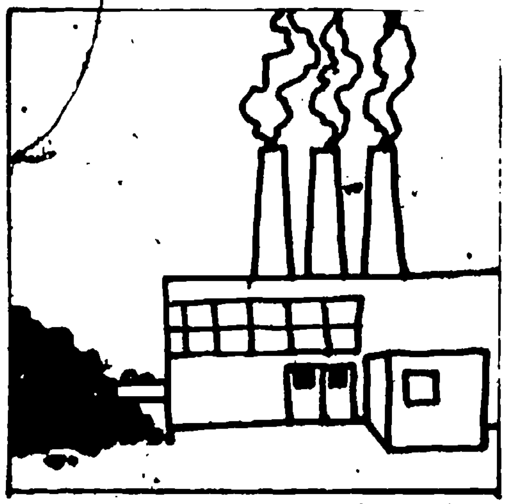
Some statements are saying something about the advantages of using gas from coal, or about disadvantages of using gas from coal. These statements should be written in the proper lines of the ACTIVITY MASTER.

FACTS

- We have the knowledge to make gas from coal now.
- Coal is the source of energy.
- The coal supply will run out someday.
- Coal mining causes damage to the environment.
- The gas from the process can be a source of chemicals for industry.
- Processing coal by gasification can reduce air pollution.
- Gas from coal can be used to generate electricity.
- Gas from coal is more expensive than natural gas.
- Gas from coal can make cars and trains run.
- The supply of coal is large, compared to oil and natural gas.
- Coal gas can be used for process heat and space heating and cooling.

Future Source

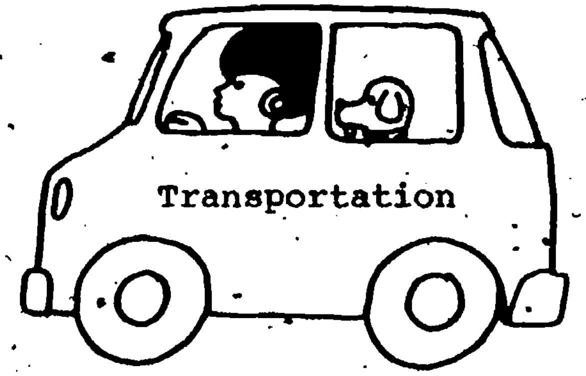




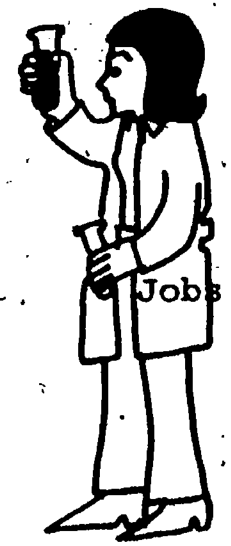
COAL GASIFICATION PLANT

Needs of People

Space heat
Space cooling
Lights
Make water hot



Automobile
Bus
Train



Machinery
Process heat
Chemical materials
Space heat
Space cooling
Lights

Advantages:

____

____

____

____

____

Disadvantages:

____

____

____

____

____

Draw a line from the coal car to the coal gasification plant to the need of the people.

Go back and look again at the FACT SHEET about coal gasification. Then find a statement that shows how the gas is made from coal and used for some purpose by people. Draw a line to show this flow. Then find another fact statement and draw another line. And so on.

Compare your picture with a classmate's.

Read each fact statement below.

Decide if the statement shows how a nuclear fusion reactor makes electricity to be used by people. If so, draw lines on the ACTIVITY MASTER from the future source to the atomic power plant to the needs of people.

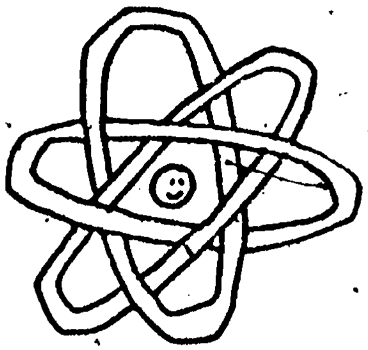
Some statements are saying something about the advantages and disadvantages of nuclear energy. These statements should be written in the proper lines of the ACTIVITY MASTER.

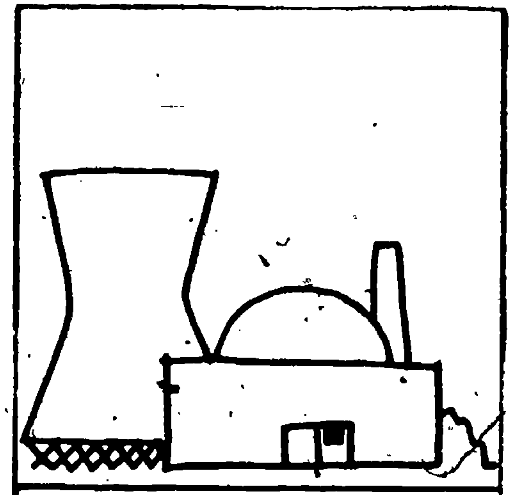
FACTS

Nuclear Fusion

- Electrical energy from the fusion reactor may be used to power industrial machinery and to provide process heat.
- These reactors will probably not be available for at least 20 years.
- This technology will be very expensive to develop.
- The fuel supply is essentially unlimited.
- Electrical energy from the reactor can be used to power electric cars and trains.
- The fusion reactor uses a nuclear fuel. (But not uranium.)
- Electrical energy from the reactor can be used for space heating and cooling.
- Using this electrical energy for cars will be difficult because we do not have adequate storage batteries.
- There are many technical problems to be solved before we can build the reactor.
- Electrical energy from the reactor can be used for lighting.
- The fusion reactor has less troublesome (bad) waste products than our present nuclear fission reactors.

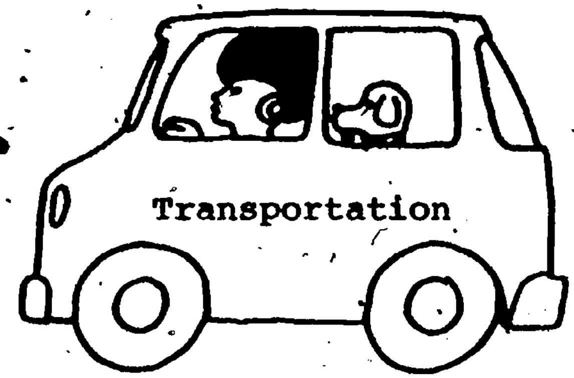
Future Source.





ATOMIC POWER PLANT

Needs of People



Space heat
Space cooling
Lights
Make water hot

Automobile
Bus
Train

Machinery.
Process heat
Chemical materials
Space heat
Space cooling
Lights

Advantages:

____

____

____

____

____

Disadvantages:

____

____

____

____

____

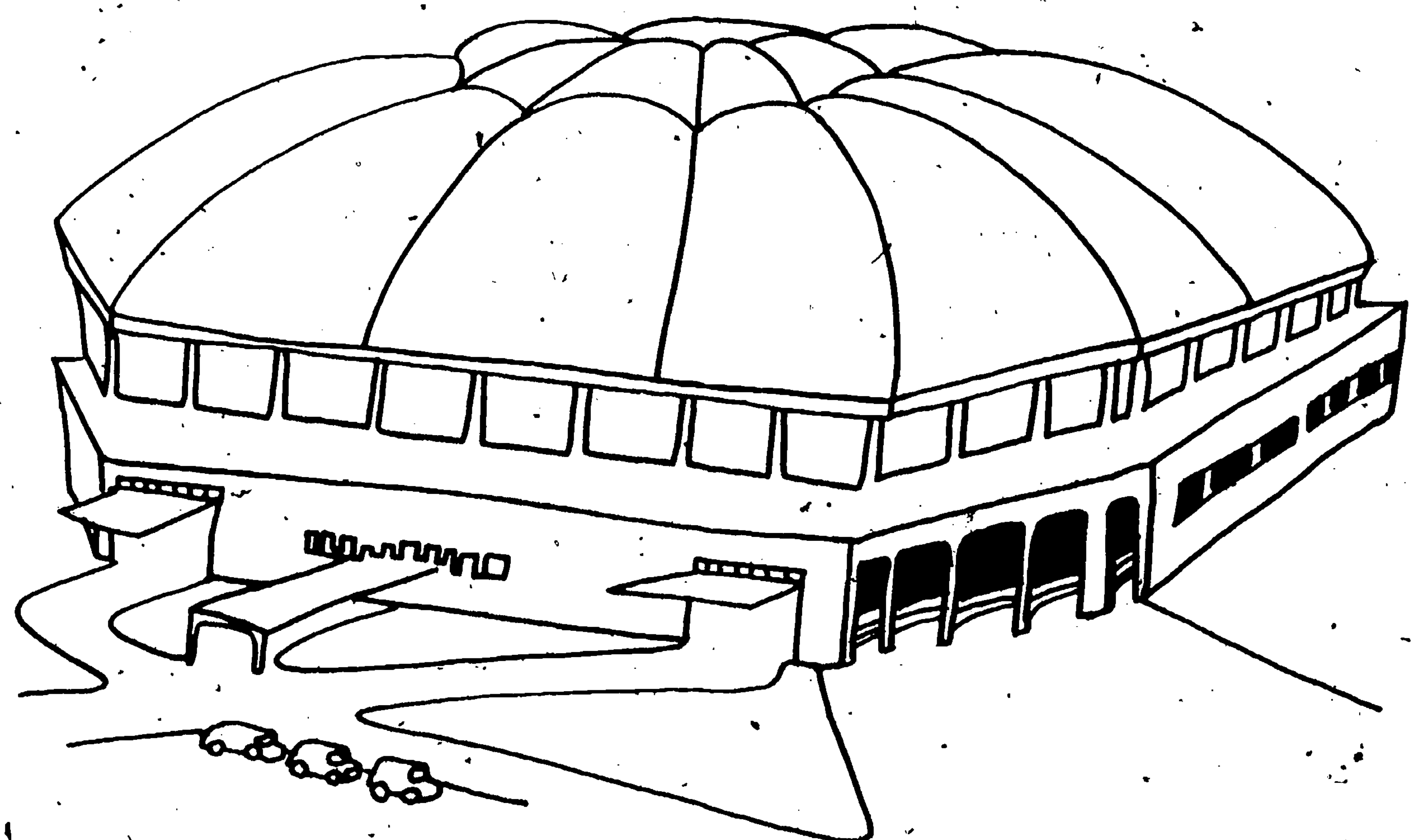
Draw a line from the future source to the atomic power plant to the need of the people.

Go back and look again at the FACT SHEET about nuclear fusion reactor. Then find a statement that shows how the reactor is used for some purpose by people. Draw a line to show this flow. Then find another fact statement and draw another line. And so on.

Compare your picture with a classmate's.

Study the picture on this page. Notice that the roof of the Silverdome is like a big balloon. The temperature inside must be kept between 65-75°. It must be raised to 85° if there is snow on the roof. Snow is heavy and must be melted quickly.

Suppose that some people want to keep the heat off in the stadium because the energy costs too much. Others want to build a concrete dome, which is very expensive to build, but the heat can be completely turned off. Write a letter to the mayor explaining what you want done with the stadium. Tell why it is important to others as well as to you.



Some people have said that nuclear energy, solar energy, or coal gasification will someday take over for oil and natural gas. Do you think these new energy sources should be used to heat places like stadiums? Are other places more important? Tell what you think these new energies should do.

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